THE BATS AND ROADSIDE MAMMALS SURVEY 2005

Final Report on First Year of Study submitted to
The Bat Conservation Trust and the Mammals Trust UK

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1.0 EXECUTIVE SUMMARY

1. This is the first report of the BCT/MTUK 'Bats and Roadside Mammals Project covering the survey year 2005. The primary aim of this report is to provide survey data for a range of mammals associated with roadside habitats

2. The Bats and Roadside Project is a partnership project of the Bat Conservation Trust (BCT) and the Mammals Trust UK (MTUK) with funding provided by MTUK.

3. The fundamental aim of the project is to increase significantly the number of records of mammals along roads and for records collected to be made available to all via the NBN. These records can then be used to 1) Inform the Planning System of the location of mammals, including BAP species 2) Establish long term local/regional monitoring of selected mammal species that complements existing mammal monitoring projects and informs local BAP's 3) Identify roadside designs that impact on mammal populations 4) Allow roadside managers to make informed decisions on how their activities impact on mammal populations

4. This is the first project to survey for live (and dead) mammals along roads at night and use time expansion bat detectors with post-survey sonogram analysis to identify bat species on a large scale. This joint approach helps meet the aspirations of the Tracking Mammals Partnership through collaborative working between different mammal organisations.

5. The project was managed by the BCT and organised by a part-time Project Manager who co-ordinated the project. All data were collected by volunteers who received training at 12 workshops. The bulk of sonogram analysis was carried out by trained volunteers.

6. Time expansion bat detectors were attached to vehicles and volunteers drove at 15 mph for 2 hours at night on each survey transect. Bat calls were recorded via the detector into mini disc recorders and recordings were analysed post-survey through sonogram analysis. All mammal sightings (dead or alive) were recorded. Through use of a GPS all records could be geo-referenced post-survey.

7. Survey participants, of all ages and survey experience, made a positive contribution to mammalian conservation and feedback from volunteers has been excellent.

8. Survey areas were selected by local Bat Groups (10) who expressed an interest in the project and were therefore generally located within the borders of a single county. Actual transects were along the existing road network in each survey area. The aim was to drive 10 separate transects, of approximately 50 km length, within each survey area. Some transects were driven twice to provide baseline data for long term, regional monitoring.

9. Bat Groups contributing data were: Avon, Cardiff & the Vale of Glamorgan, Central Scotland, Clyde, Dorset, Hampshire, Isle of Wight, Kent, North Ceredigion, and Warwickshire.

10. Total volunteer effort was estimated at 91 days (55 days survey effort and 36 days of sonogram analysis).

11. A total of 3573 km of road were driven with 386 km repeat surveyed.

12. A total of 4719 bats were recorded from seven bat species/species groups and a total of 399 other mammal species were recorded from 21 species groups.

13. Total numbers of bat species encountered were: common pipistrelle, 2744; soprano pipistrelle, 985; noctule, 119; Leisler's, 19; serotine, 129; *Myotis* spp. 70; Nathusius' pipistrelle 4; unidentified pipistrelles 582; unidentified bats, 60.

14. This has been the first systematic survey of Leisler's and Nathusius' pipistrelle in the UK with bat detectors.

15. Total numbers of the top 7 other mammal species encountered were: rabbits, 167; bats, 68; foxes, 54; hedgehogs, 20; mice, 19; hares, 10; and badgers, 10. The total number of unidentified mammals was 11.

16. The 5118 quality-assured, geo-referenced mammal records collected are in the process of being made available to all via placement on the NBN Gateway.

17. Soprano pipistrelle bats were encountered more frequently in Scotland than England or Wales.

18. Significant differences in encounter rates of bats were found with respect to survey area, environmental conditions, time of night and month.

19. No significant regional differences were found in peak frequencies of either common or soprano pipistrelle bats

20. There were significant differences in the number of rabbit and fox encounters between months.

21. There were differences in the proportion of mammal species encountered between Environmental Zones.

22. In the longer term this dataset will be used to inform climate change models, determine key roadside habitats that are beneficial to mammalian biodiversity and identify large-scale distributional changes.

2.0 INTRODUCTION

The Bat Conservation Trust (BCT) initiated a partnership with the Mammals Trust UK (MTUK) to carry out a survey of nocturnal roadside mammals at selected areas throughout the UK. The partnership approach helps meet a fundamental objective of the Tracking Mammals Partnership which is a collaborative initiative, involving 24 UK organisations, which aims to improve the quality, quantity and dissemination of information on the status of mammal species in the UK. Funding for the project was provided by the MTUK. Some bat groups also made a financial contribution.

The project built on previous nocturnal mammal roadside projects devised and managed by the BCT in the Republic of Ireland and Hertfordshire in 2002/2003.

The fundamental objective was to increase the number of geo-referenced mammal records along roads and to ensure that such records collected would further the conservation of roadside mammals through ensuring collected mammal records were available to land managers, and thus helping inform planning decisions, and providing records to researchers to identify roadside features that are beneficial to selected mammal populations

The project was designed to be cost-effective and to lay the foundation for long term sustainability through empowering volunteers to carry out much of the required work, ranging from fieldwork to sonogram analysis. A part-time Project Co-ordinator was employed by the Bat Conservation Trust to run the project.

Aims

1. Considerably increase the present number of bat/mammal records through implementing a cost-effective mammal survey method and develop a system to ensure such records are available to land managers.

2. Develop a long-term method for monitoring populations for selected species at the local and regional levels.

3. Collect data systematically to enable future identification of road designs and roadside features that impact on mammal populations.

4. Inform road managers of the impact 'their' roads have on roadside mammal populations.

3.0 METHODS

3.1 General Approach

The general approach was for volunteers to drive along roads at night recording all mammals encountered.

The full survey protocol is presented in Appendix 1.

3.2 Survey Areas and Road Transects

Each county was divided into 15 km blocks (225 square km) and surveyors were asked to identify a 50km road route within each block using 1:50 000 Ordnance Survey maps. Surveyors were advised to identify only minor roads for safety reasons.

3.3 Equipment

A Tranquility time expansion detector attached to a mini disc recorder was fixed to the rear window of a vehicle with an adapted camera car window clamp. The detector was set to slow down sound (to convert from ultrasonic to audible) by 10 times. The sensitivity of the detector was set to maximum so that it recorded continuously and was not triggered by ultrasonic noise. The sampling period was set to 320 milliseconds (ms). The detector 'listened' for any ultrasonic noise for 320 ms then processed this noise for 3200 ms. During the processing period the detector stopped 'listening' for ultrasonic noise. This approach meant that continuous snapshots of ultrasonic noise were taken every 3520 ms (320 + 3200) during the survey period.

A Personal Digital Assistant (PDA) (Mitac Mio 168) with an integrated Global Positioning System (GPS) was used on each survey. Digitised maps (1:50 000) were loaded into the PDA and Memory map software and, through integration with GPS data, enabled surveyors to identify their exact position at any time during the survey.

The above approach meant that all records had the potential to be geo-referenced post-survey through use of a novel software programme developed by Martin Newman, the BCT IT consultant

Surveyors used a flashing orange beacon to warn other road users of their slow speed.

Surveyors were provided with standardised recording sheets to record any mammals sighted (dead or alive) during the survey and to record additional survey details (see Appendix 1).

3.4 Surveying transects

Prior to the start of the survey surveyors attached all equipment to the vehicle and ensured that all equipment was working. Fresh batteries were placed in the detector to ensure maximum sensitivity. The survey started 45 mins post sunset and the vehicle was driven at approximately 24 km/hr (15 mph) for about 2 hours. On each survey night approximately 50 km were driven and 2 hours of recordings made.

3.5 Recruiting local Bat Group Volunteers

Bat groups were identified from Scotland and Wales by the BCT Scottish and Welsh Bat Officers and in England by the BCT Bat Group Officer. Although the project aimed to recruit 5 Bat Groups a total of 10 Bat Groups took part in the project. Within each group an average of 18 volunteers contributed to the project.

Participating groups were Avon, Cardiff and the Vale of Glamorgan, Central Scotland, Clyde, Dorset, Hampshire, Isle of Wight, Kent, North Ceredigion, and Warwickshire.

3.6 Data Handling

Once a survey had been completed, surveyors send mini discs and GPS files to the Project Co-ordinator. The co-ordinator transferred the mini disc recordings into a dedicated computer and converted them into digital *.wav files. These files were then burnt onto a CD and sent to a trained volunteer for subsequent sonogram analysis. This approach meant that all recordings were centralised before analysis and provided backup for the data.

The data from survey forms containing bat and terrestrial mammal data were entered into an Excel spreadsheet and time data were converted to a suitable format for analysis.

3.7 Sonogram Analysis

Sonogram analysers analysed each CD and recorded bat species and the time at which each species was encountered. In cases where species identity could not be ascertained with confidence these were flagged up for further investigation by the Project Coordinator.

The protocol for sonogram analysis is presented in Appendix 2.

3.8 Geo-referencing Mammal Encounters

Once the sonogram analysis was completed the results were entered into an Excel spreadsheet and converted to a suitable analysis format by the Project Coordinator. Bat and mammal encounter times were then run through the 'geo-referencing' program developed by Martin Newman, the IT consultant for BCT. Each record could then be assigned a Grid Reference accurate to 20-200 m.

3.9 Investing in Volunteers

Due to the necessary complexity of the project it was essential that volunteers were provided with training. Two types of training workshops for volunteers were run 1) Training in the survey method 2) Training in sonogram analysis

- Training in the survey method: Seven workshops were held in Wales, Scotland and England and volunteers were trained in all aspects of the survey method. This included a practical demonstration of using the equipment. A total of 64 volunteers were provided with training.

- Training in sonogram analysis: Five workshops were held in Wales, Scotland and England and volunteers trained in analysing sonograms on BatSound software. A standard training package was developed to ensure consistency of training which was given to each volunteer. A total of 46 volunteers were trained in sonogram analysis.

These training workshops were critical to the success of the project. Firstly they provided an opportunity to explain in detail the project to the volunteers and secondly training ensured the protocol was implemented properly. Volunteers attending workshops found it an enjoyable experience and appreciated the efforts made.

The long term objective is for trained volunteers to train new recruits in subsequent years and thus allow strong capacity building for the future

Communication is an essential part of volunteer management. The Project Co-ordinator received over 600 e-mails from volunteers during the project and spent over 20 hours talking to them on the phone. This communication and support helps to ensure effective volunteer delivery.

3.10 Volunteer Contribution

Volunteer contribution to this project was immense and they contributed an estimated 91 days (51 days on surveying and 36 days on sonogram analysis). This is equivalent to employing a part time position of 2 days per week (similar to the contribution of the present Project Co-ordinator) and allowed the project to run cost-effectively.

3.11 Project Management

There were 6 main areas of work in running the project: 1) Designing the project 2) Training volunteers 3) Managing the survey 4) Analysis and report writing 5) Sonogram Analysis and 6) Implementing the survey (Figure 1).

Figure 1. Time management: Blue = volunteer contribution and green = coordinator contribution.

Overall contribution to the project was divided almost equally between the volunteers and the paid Project Co-ordinator. All the sonogram analysis and survey implementation was carried out by volunteers and the investment of 8% of the Project Co-ordinators time in training was an excellent use of resources. More than this was the fact that the skills and knowledge of the Project Co-ordinator were transferred to the volunteers as these can be used in other ways to enhance conservation activities.

4.0 RESULTS

4.1 Survey effort

Detail of survey effort are presented in Table 1 in Appendix 3.

4.2 Description of Dataset Generated

A total of 74 routes were surveyed and analysable bat sonogram data for 60 (5 = no returns, 9 = not competed successfully). For other mammal data 72 (4 = no returns) sheets were analysable. Of the unsuccessful bat sonogram data returns, 1 was attributable to a corrupt minidisc, 1 to a lost minidisk, 3 to problems with the Pettersson D240x (now solved) and 4 due to unknown reasons (but possibly due to a low bat detector sensitivity setting being selected). Details of all surveys are presented in Table 2 in Appendix 3.

A total of 3573 km were driven and of this total 2898 km were surveyed successfully for bats (with resultant analysable sonograms) and 3381 km for other mammals (mammal datasheet was returned).

A total of 4719 bats were recorded from 7 bat species/species groups and a total of 399 other mammal species were recorded from 21 species/species groups.

A breakdown of all survey transects driven with total numbers of mammal encounters are presented in Tables 3 and 4 in Appendix 3.

The distribution of survey areas can be seen in Figure 2.

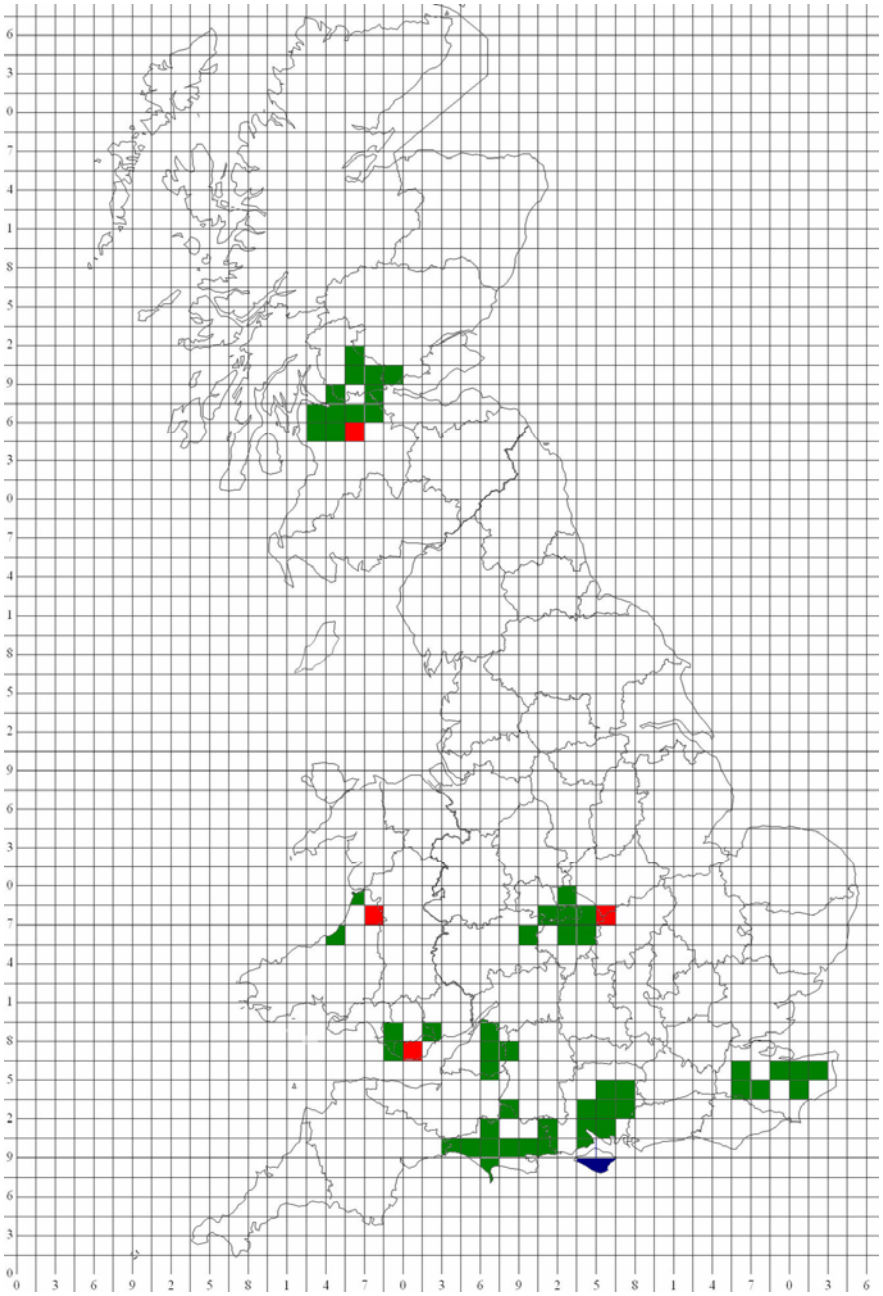

Figure 2. Map showing the distribution of survey blocks. Green = single surveys, Red = repeated blocks and Blue = survey repeated 5 times.

4.3 Bats

4.3.1 Bats encountered per kilometre

The overall mean number of bats encountered for each species/species group is presented in Table 1. Mean numbers of each bat species encountered per kilometre for each county/region are presented in Table 5 in Appendix 3.

Table 1. Overall mean bat encounters per kilometre

Species/Species group	Bat encounters/km	Rank
all bat species	1.628	
common pipistrelle	0.947	1
soprano pipistrelle	0.340	2
unidentified pipistrelles	0.201	3
Nathusius' pipistrelle	0.001	9
Myotis spp.	0.024	6
Leisler's bat	0.007	8
noctule	0.041	5
serotine	0.045	4
unidentifed bats	0.021	7

4.3.2 Within-night variation in the number of bat encounters

The objective here was to test whether bat encounters varied with time of night. Each nightly survey period was divided into 4 quarters of 30 minutes duration starting at the beginning of each survey (45 mins post-sunset). The total number of bat encounters was then summed for each quarter.

4.3.2.1 All bat species

There was a difference in bat encounters between quarters with maximum bats encountered in the 2nd and 3rd quarters and minimum in 1st and 4th quarters (Figure 3). The total number of bat encounters recorded during the 2nd and 3rd quarters is almost double that of the 1st and 4th quarters.

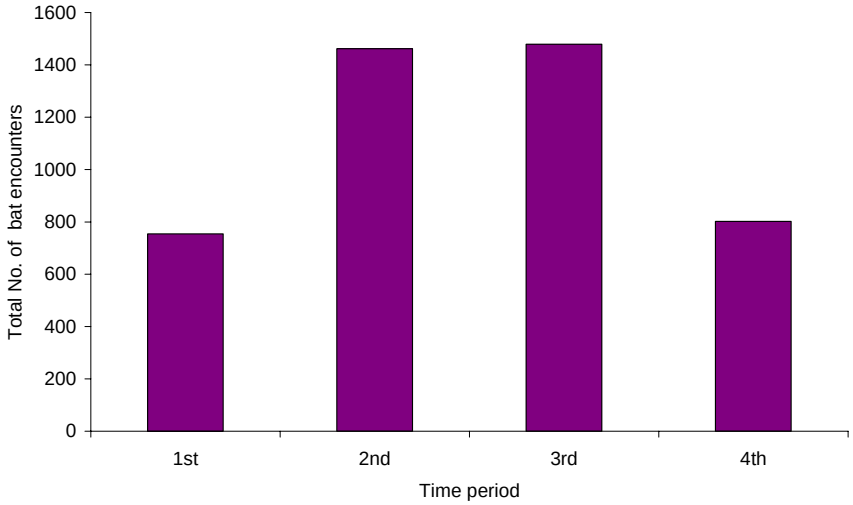

Figure 3. Total bat encounters per time period.

4.3.2.2 Common pipistrelle (*Pipistrellus pipistrellus*)

There was an apparent difference in bat encounters between quarters with maximum bats encountered in the 2nd and 3rd quarters and minimum bats encountered in the 1st and 4th quarters (Figure 4). The total number of bat encounters recorded during the 2nd and 3rd quarters is slightly more than double that of the 1st and 4th quarters.

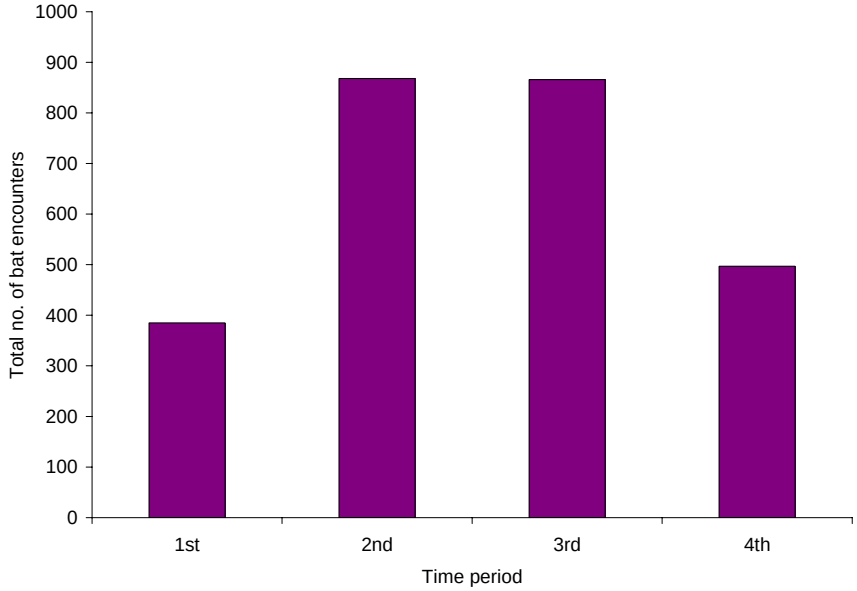

Figure 4. Total common pipistrelle bat encounters per time period.

4.3.2.3 Soprano pipistrelle (*Pipistrellus pygmaeus*)

There was an apparent difference in bat encounters between quarters with maximum bats encountered in the 2nd and 3rd quarters and minimum bats encountered in the 1st and 4th quarters (Figure 5). The total number of bat encounters recorded in the 2nd and 3rd quarters was slightly more than double than of the 1st and 4th quarters and this shows a similar pattern to the common pipistrelle bat.

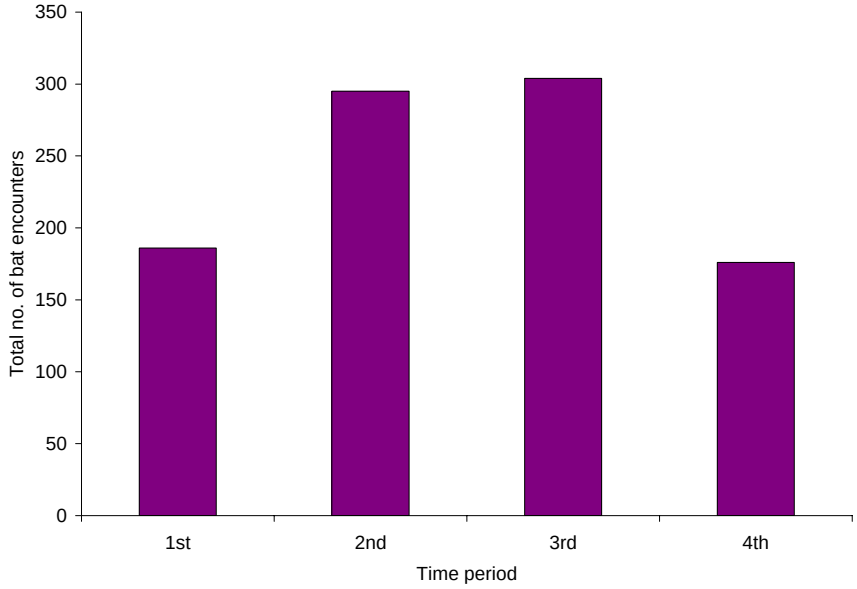

Figure 5. Total soprano pipistrelle bat encounters per time period.

4.3.2.4 Nathusius' pipistrelle (*Pipistrellus nathusii*)

There are currently too few data for any meaningful analyses.

4.3.2.5 *Myotis* spp.

There was an apparent difference in bat encounters between quarters with encounter rate increasing steadily from the 1st to the 3rd quarter and dropping off in the 4th quarter (Figure 6). This shows a different pattern to both the common and soprano pipistrelle.

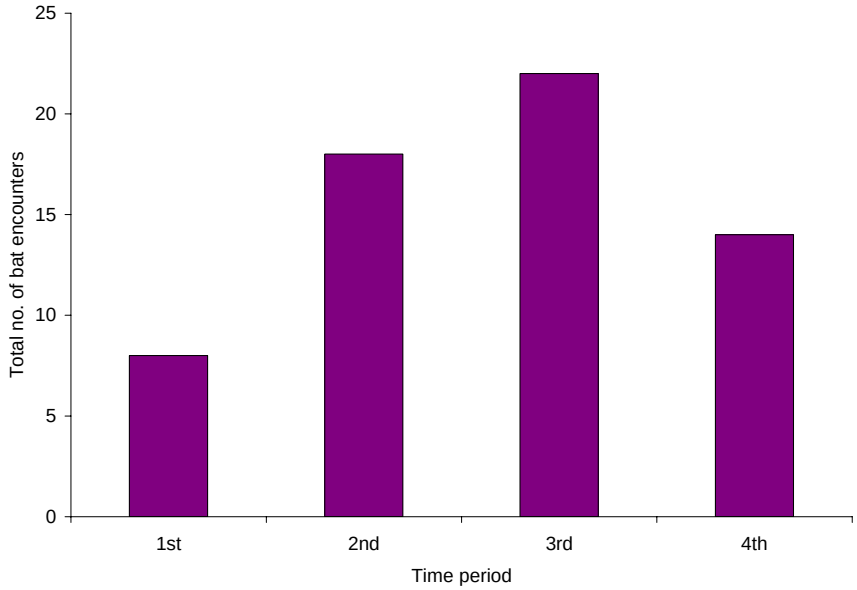

Figure 6. Total *Myotis* spp. bat encounters per time period.

4.3.2.6 Leisler's bat (*Nyctalus leisleri*)

There was a large difference in Leisler's bat encounters and quarter. The 2nd and 3rd quarters showed the highest encounters (Figure 7). The encounter rates in the 1st and 4th quarter were\less than half the encounter rates recorded in the 2nd and 3rd quarters.

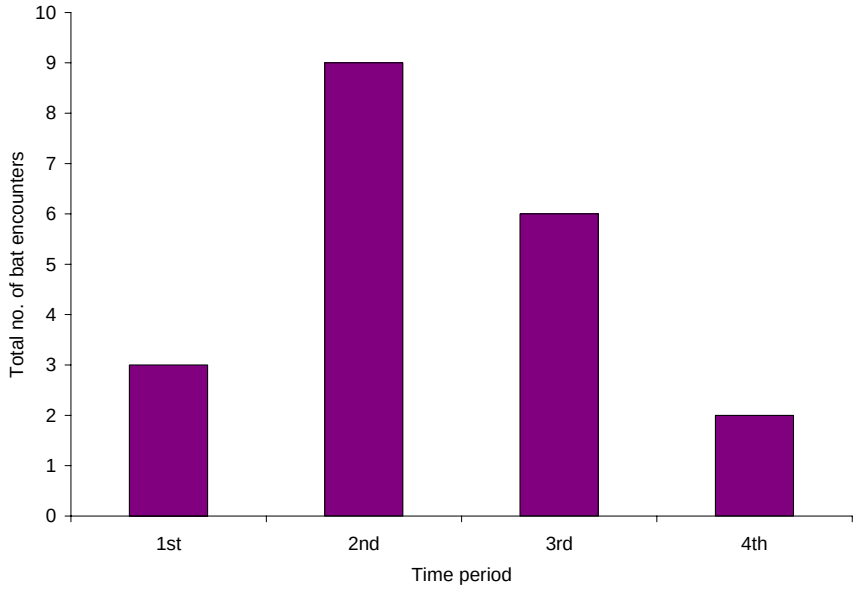

Figure 7. Total Leisler's bat encounters per time period.

4.3.2.7 Noctule (*Nyctalus noctula*)

There was a large difference in Noctule bat encounters and quarter (Figure 8). Highest encounters were recorded in the 1st quarter and lowest in the 4th quarter.

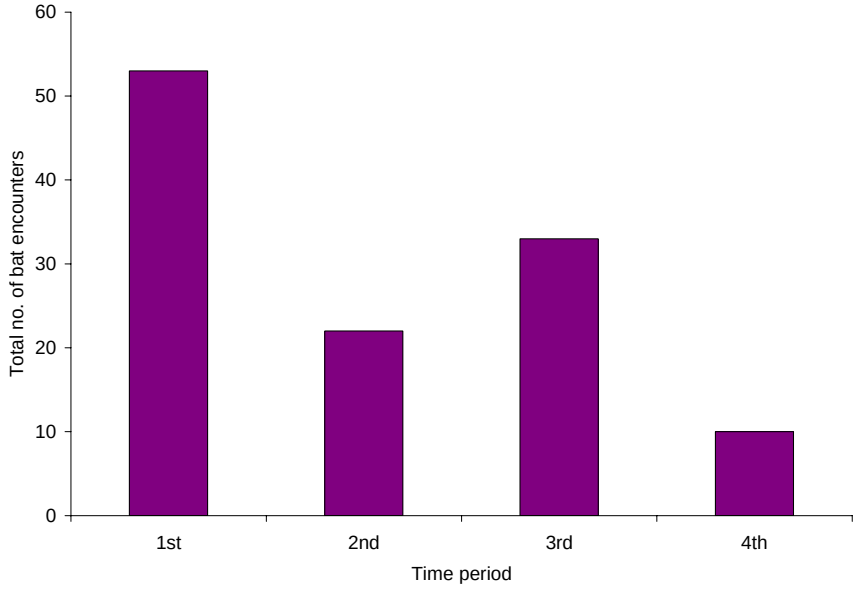

Figure 8. Total noctule bat encounters per time period.

4.3.2.8 Serotine (*Eptesicus serotinus*)

The 1st, 2nd and 3rd quarters showed similar encounter rates but there was a noticeably reduced encounter rate in the 4th quarter (Figure 8).

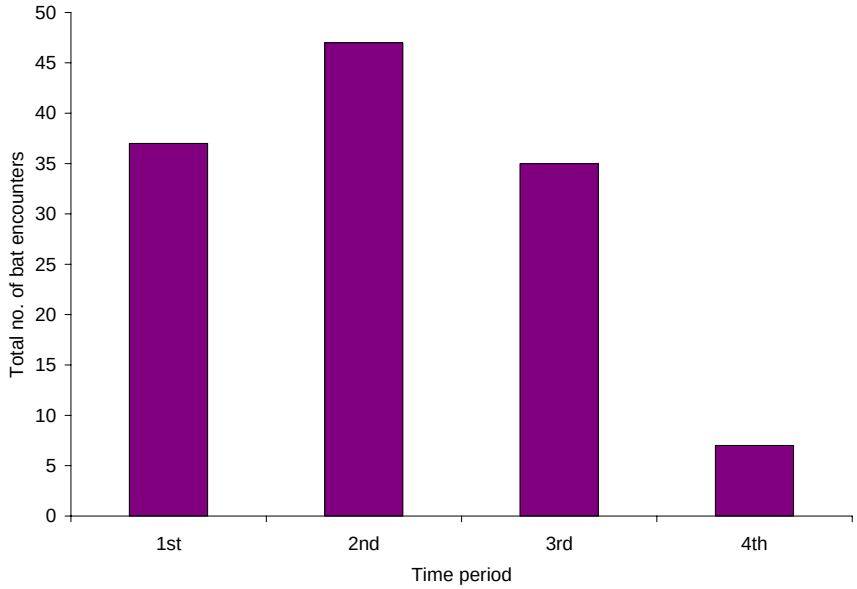

Figure 8. Total serotine bat encounters per time period.

Thus there were differences in the total number of bat encounters per time period which varied between species. Peak numbers of bat encounters occurred for different species in the 1st, 2nd or 3rd time periods but not for the 4th time period.

4.3.3 Seasonal variation in the number of bat encounters

The objective here was to test whether bat encounters varied with survey month. The mean number of bat encounters was calculated for each month. All bat species (groups) encounters were initially looked at followed by individual species.

4.3.3.1 All bat species

Peak encounters were recorded in July and August with June recording the lowest encounter rate (Figure 10).

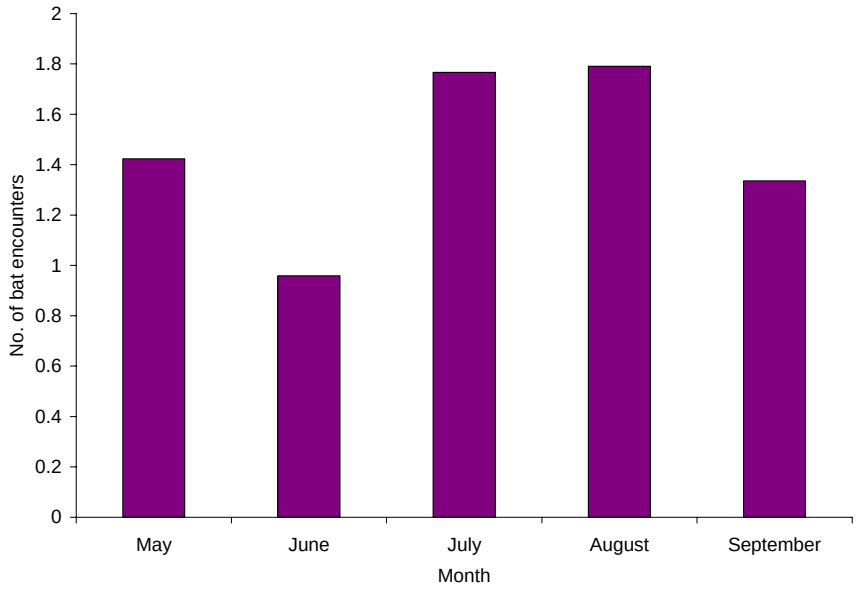

Figure 10. Mean number of bat encounters per kilometre for each survey month.

4.3.3.2 Common pipistrelle (*Pipistrellus pipistrellus*)

Peak encounters were recorded in July and August with May, June and September recording similar lower encounter rates (Figure 11).

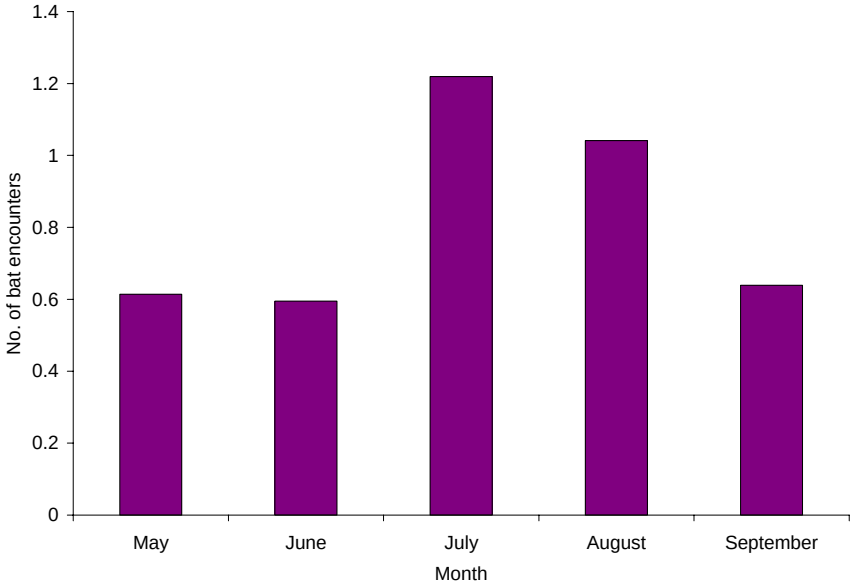

Figure 11. Mean number of common pipistrelle bat encounters per kilometre for each survey month.

4.3.3.3 Soprano pipistrelle (*Pipistrelllus pygmaeus*)

Highest encounters were in May (about twice as high as June and July) and there was a large increase in August which decreased in September (Figure 12). This shows a different pattern from the common pipistrelle bat.

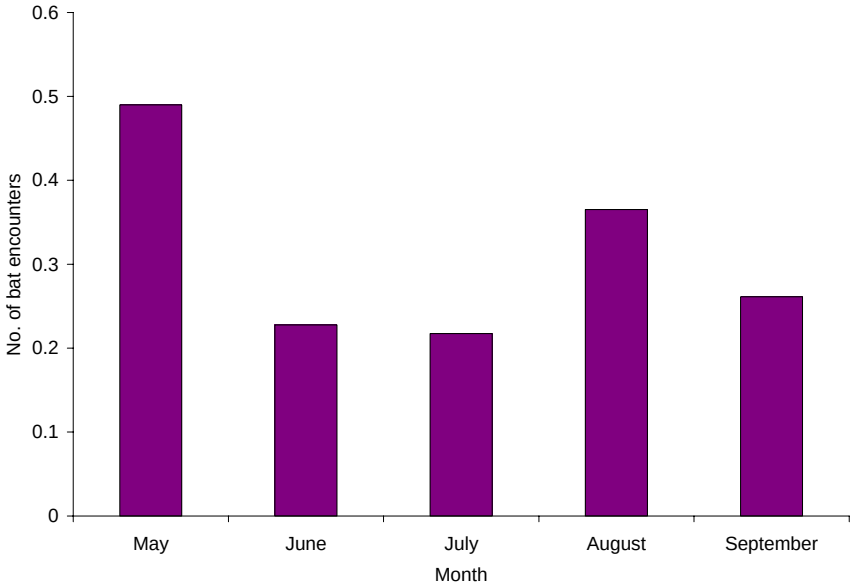

Figure 12. Mean number of soprano pipistrelle bat encounters per kilometre for each survey month.

4.3.3.4 Nathusius' pipistrelle (*Pipistrellus nathusii*)

Too few data to carry out analysis.

4.3.3.5 *Myotis* spp.

Highest encounters were in June and August with dips in activity outside these months (Figure 13). This shows a different pattern from either the soprano pipistrelle or the common pipistrelle based on number of encounters.

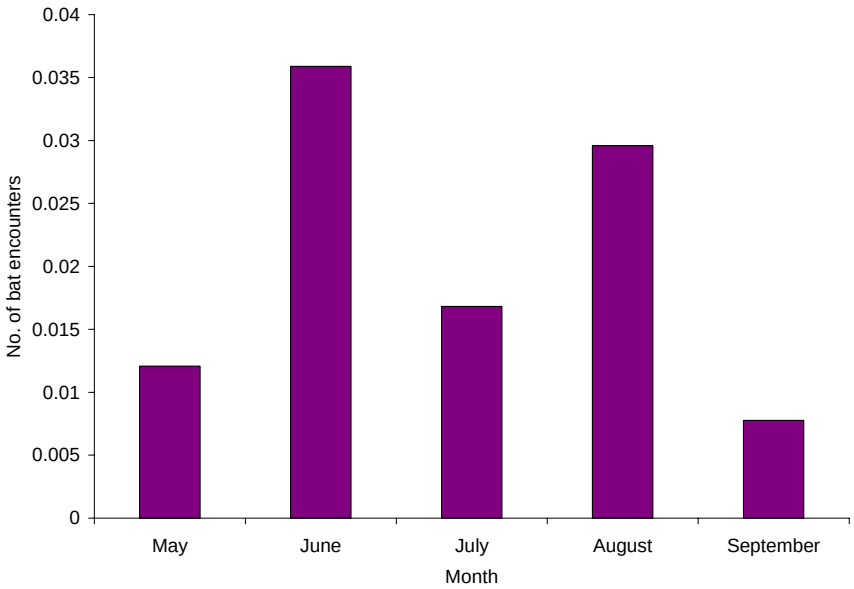

Figure 13. Mean number of *Myotis* species bat encounters per kilometre for each survey month.

4.3.3.6 Leisler's bat (*Nyctalus leisleri*)

Highest encounters were in May and September with very low encounters in the remaining months (Figure 14). However, it must be noted that the data set is small.

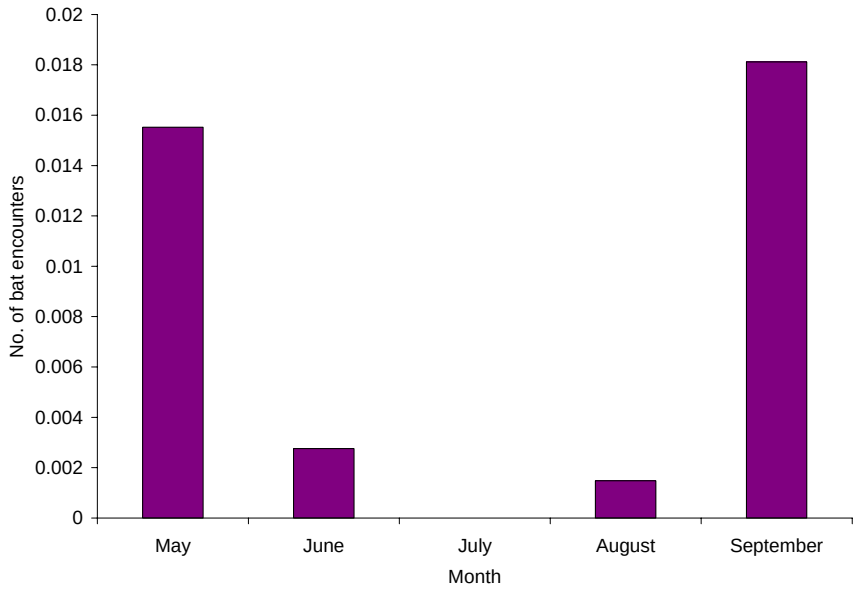

Figure 14. Mean number of Leisler's bat encounters per kilometre for each survey month.

4.3.3.7 Noctule (*Nyctalus noctula*)

Highest encounters were in May and September (highest). June and August showed the lowest encounters (Figure 15).

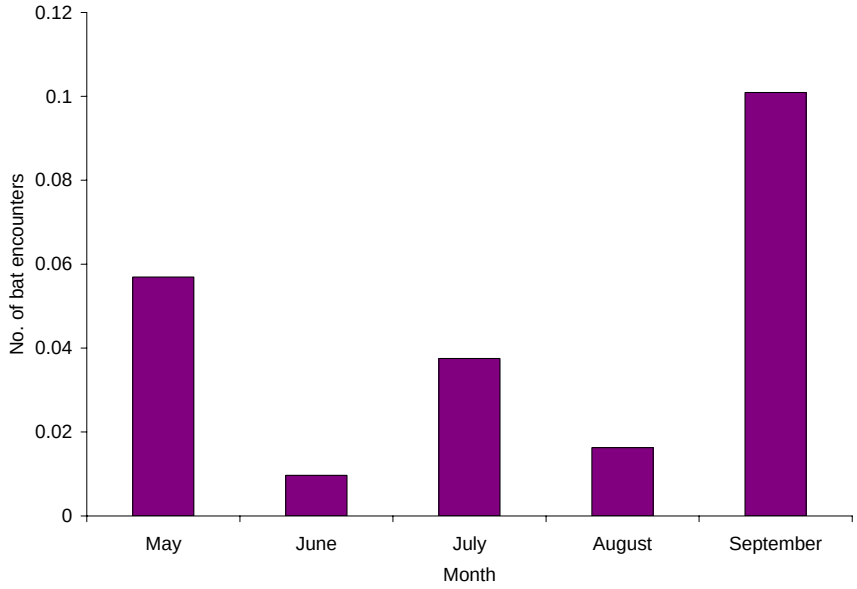

Figure 15. Mean number of noctule bat encounters per kilometre for each survey month.

4.3.3.8 Serotine (*Eptesicus serotinus*)

Highest encounters were in May, intermediate encounters in July and August and lowest encounters in June and September (Figure 16).

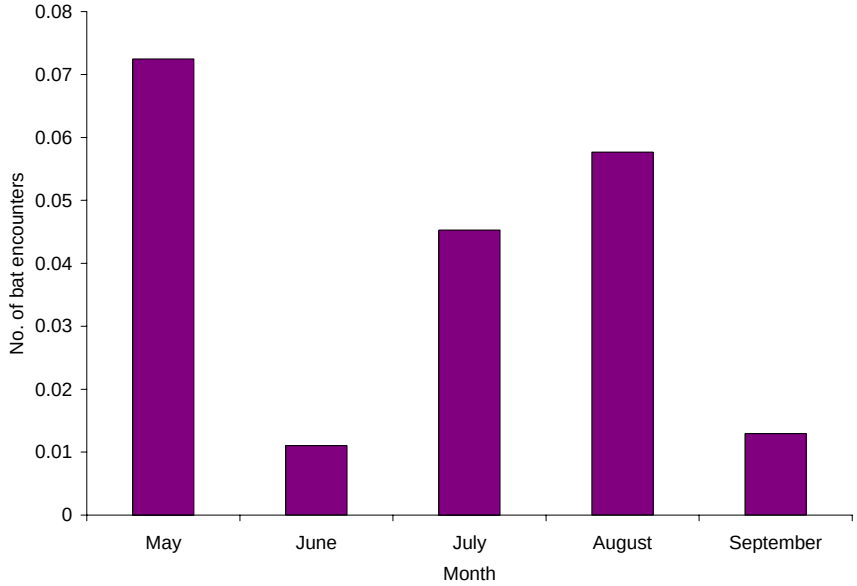

Figure 16. Mean number of serotine bat encounters per kilometre for each survey month.

Thus the number of bat encounters recorded varied between months and also between the different species studies.

4.3.4 Encounter rates and Environmental Conditions

To investigate whether there were any relationships between bat encounter rate and environmental conditions such as temperature, wind speed and cloud cover, which were recorded at the start and end of each survey, statistical tests were performed on the data for each species separately.

4.3.4.1 All bat species

There was a significant positive correlation between start temperature and number of bat encounters (Appendix 3, Table 6). All other statistical tests between number of bat encounters and climatic variables were not significant.

4.3.4.2 Common pipistrelle (*Pipistrellus pipistrellus*)

There was a significant positive correlation between start temperature and number of common pipistrelle bat encounters (Appendix 3, Table 6) and end temperature and number of common pipistrelle bat encounters (Appendix 3, Table 6). All other statistical tests between number of common pipistrelle bat encounters and climatic variables were not significant.

4.3.4.3 Soprano pipistrelle (*Pipistrelllus pygmaeus*)

There was a significant positive correlation between start temperature and number of soprano pipistrelle bat encounters (Appendix 3, Table 6) and end temperature and number of soprano pipistrelle bat encounters (Appendix 3, Table 6). All other statistical tests between number of soprano pipistrelle bat encounters and climatic variables were not significant.

4.3.4.4 Nathusius' pipistrelle (*Pipistrellus nathusii*)

There is currently insufficient data for meaningful analyses

4.3.4.5 *Myotis* spp.

All statistical tests between number of Myotis bat encounters and climatic variables were not significant.

4.3.4.6 Leisler's bat (*Nyctalus leisleri*)

All statistical tests between number of Leisler's bat encounters and climatic variables were not significant.

4.3.4.7 Noctule (*Nyctalus noctula*)

All statistical tests between number of Noctule bat encounters and climatic variables were not significant.

4.3.4.8 Serotine (*Eptesicus serotinus*)

All statistical tests between number of serotine bat encounters and climatic variables were not significant.

Thus there were significant relationships between temperature and the number of bat encounters recorded for pipistrelle bats and all bats grouped together but there were no significant relationships for any of the other species studied.

4.3.5 Baseline data on long term monitoring transects

The objective was to provide baseline data upon which long term monitoring of roadside bat populations can be built. For these transects volunteers were asked to repeat in August one of the transects that they carried out in July ensuring that they drove exactly the same route.

4.3.5.1 All bat species

Of the 5 transects that were repeat surveyed the mean number of total encounters were similar (Figure 17).

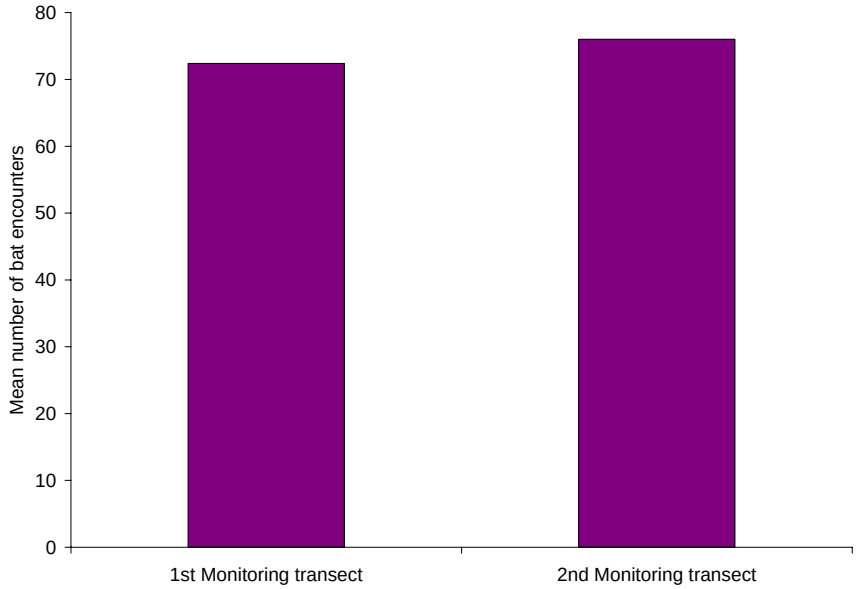

Figure 17. Mean number of bats encounters for 1st and 2nd monitoring transects. Total number of survey block repeated = 5.

4.3.5.2 Common pipistrelle (*Pipistrellus pipistrellus*)

Of the 5 transects that were repeat surveyed the mean number of total encounters was slightly lower in the second survey (Figure 18).

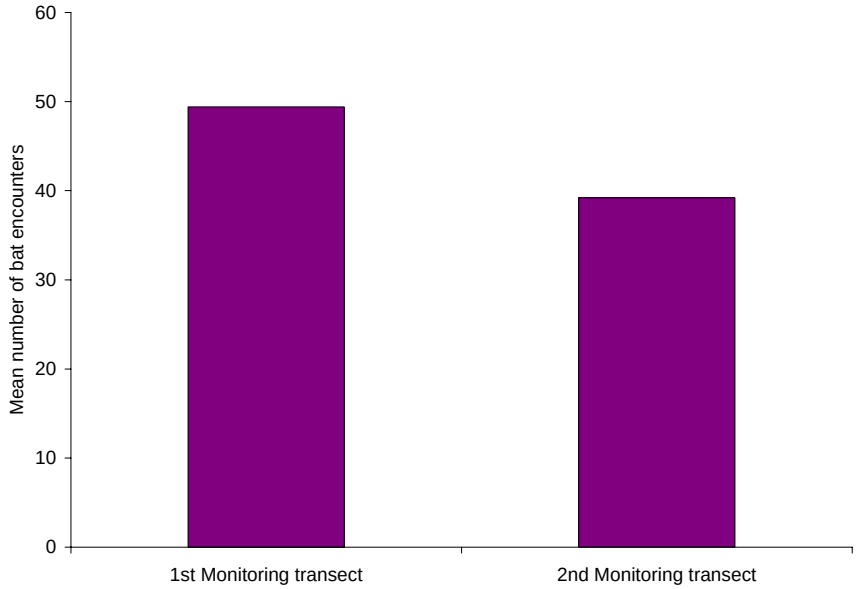

Figure 18. Mean number of common pipistrelle bat encounters for 1st and 2nd monitoring transects. Total number of survey block repeated = 5.

4.3.5.3 Soprano pipistrelle (*Pipistrelllus pygmaeus*)

Of the 5 transects that were repeat surveyed the mean number of total encounters was a third higher than in the second survey (Figure 19). Again this shows a different pattern from the common pipistrelle bat.

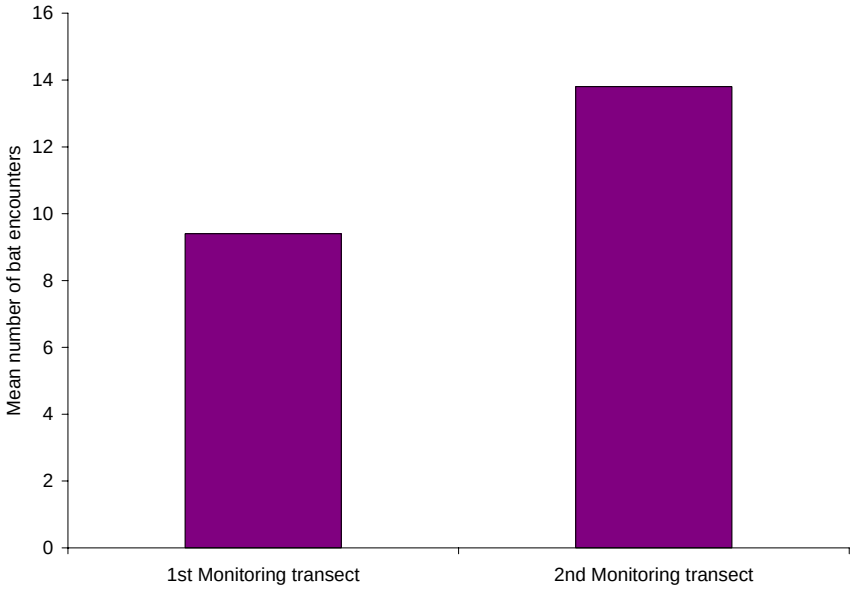

Figure 19. Mean number of soprano pipistrelle bat encounters for 1st and 2nd monitoring transects. Total number of survey block repeated = 5.

4.3.5.4 Nathusius' pipistrelle (*Pipistrellus nathusii*)

There is currently insufficient data for meaningful analyses

4.3.5.5 *Myotis* spp.

There is currently insufficient data for meaningful analyses

4.3.5.6 Leisler's bat (*Nyctalus leisleri*)

There is currently insufficient data for meaningful analyses

4.3.5.7 Noctule (*Nyctalus noctula*)

There is currently insufficient data for meaningful analyses

4.3.5.8 Serotine (*Eptesicus serotinus*)

There is currently insufficient data for meaningful analyses

4.3.6 Comparison of Bat Species

4.3.6.1 Bat species encounter rates

Bat species were encountered in different abundances during the survey (Fig 20).

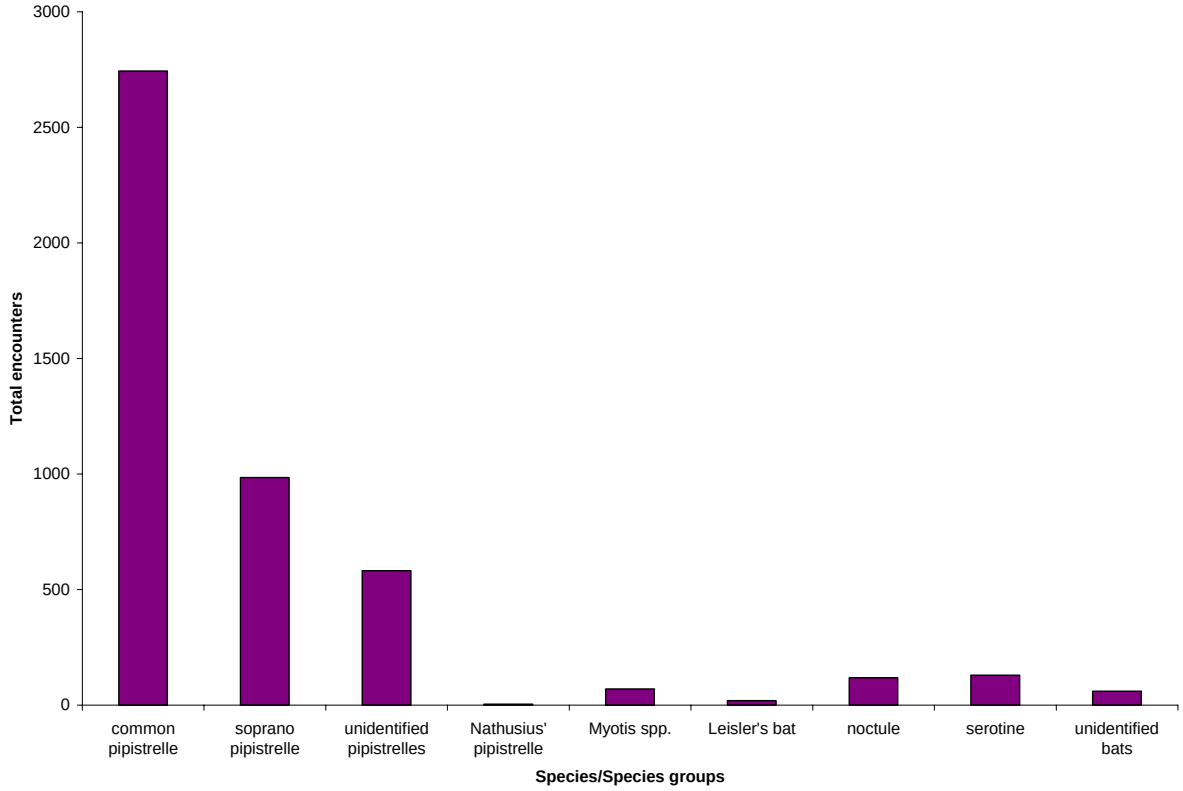

Figure 20. Total number of bats and bat groups encountered overall

The common pipistrelle had the highest encounter rate (2744) which was more than double that of the next highest encounter rate, the soprano pipistrelle (985). The next highest group were the 'unidentified pipistrelles' (582) (where peak frequencies of pipistrelle bats, recognised as pipistrelle bats from the shape of their call, were intermediate between common and soprano pipistrelles they were classified as 'unidentified common/soprano pipistrelles'). Serotine and noctule encounters were similar (129 and 119 respectively) followed by *Myotis* species (70). The five species comprising the '*Myotis* species' category all produce similar calls and it was not possible to assign individual calls to species with confidence. There were 19 encounters of Leisler's bat and, with 4 encounters, Nathusius' pipistrelle was the rarest bat identified. Sixty bats could not be assigned to species / species group with confidence and were assigned to the 'other' category.

4.3.6.2 Comparison of common and soprano pipistrelle encounters.

Common and soprano pipistrelles were the most frequently recorded species on the survey and this provided an opportunity to investigate their relative abundance to each other along roads across the country (Figure 21). The overall ratio of common to soprano pipistrelles across all survey areas was 2.8.

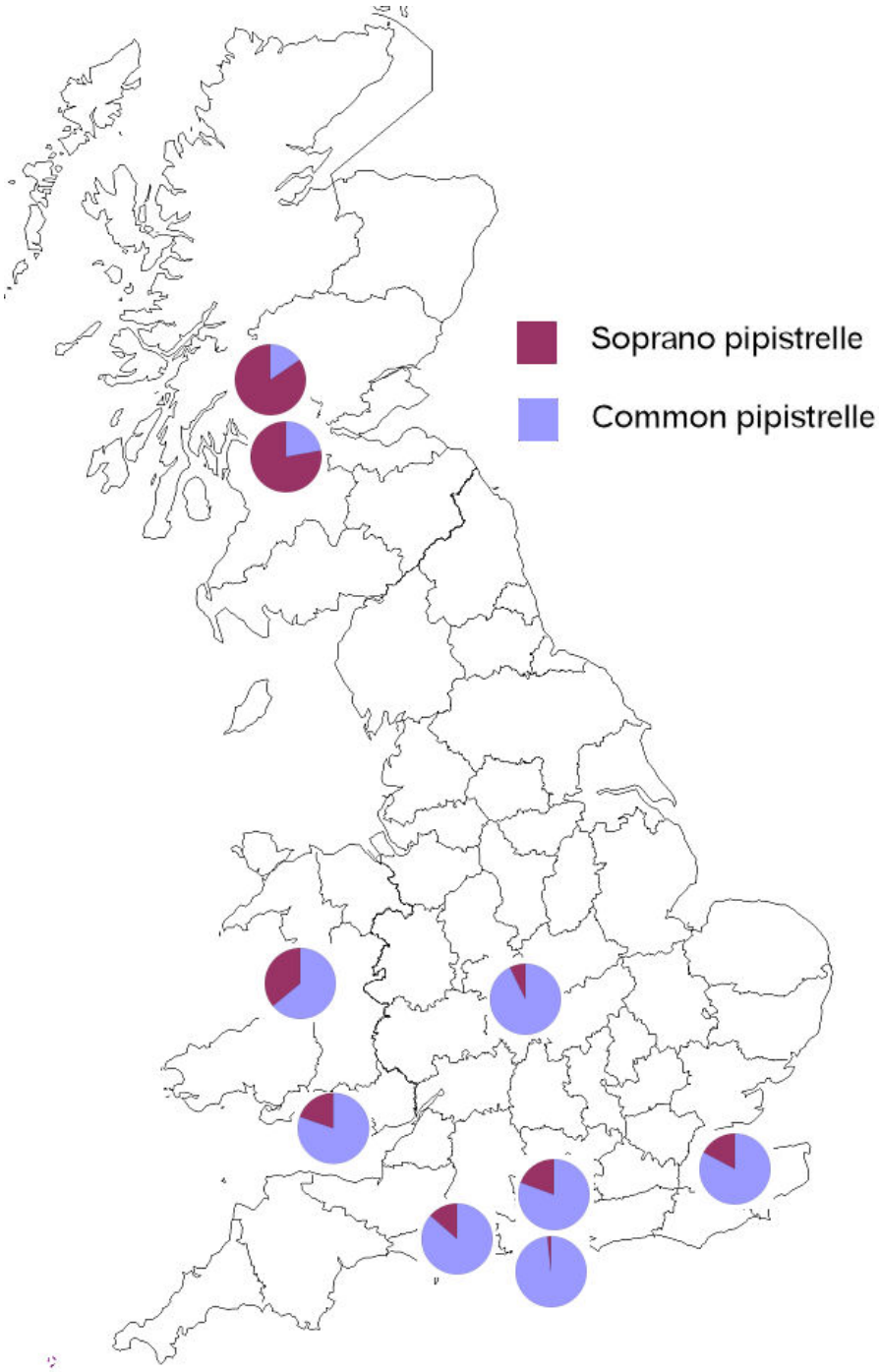

Figure 21. Ratios of common to soprano pipistrelles for each county surveyed

The common pipistrelle predominates in each survey area in England and Wales but results from Scotland show a marked difference with the soprano pipistrelle accounting for 75% of pipistrelle encounters in both Central Scotland and Clyde.

4.3.6.3 Isle of Wight

The Isle of Wight Bat Group were enthusiastic participants in the survey but the small size of the island allowed only 2 transects to be driven. This provided a unique opportunity to compare seasonal activity from the same transect driven throughout the summer (Fig 22). Only one transect is shown as there was missing data on the other transect due to equipment failure.

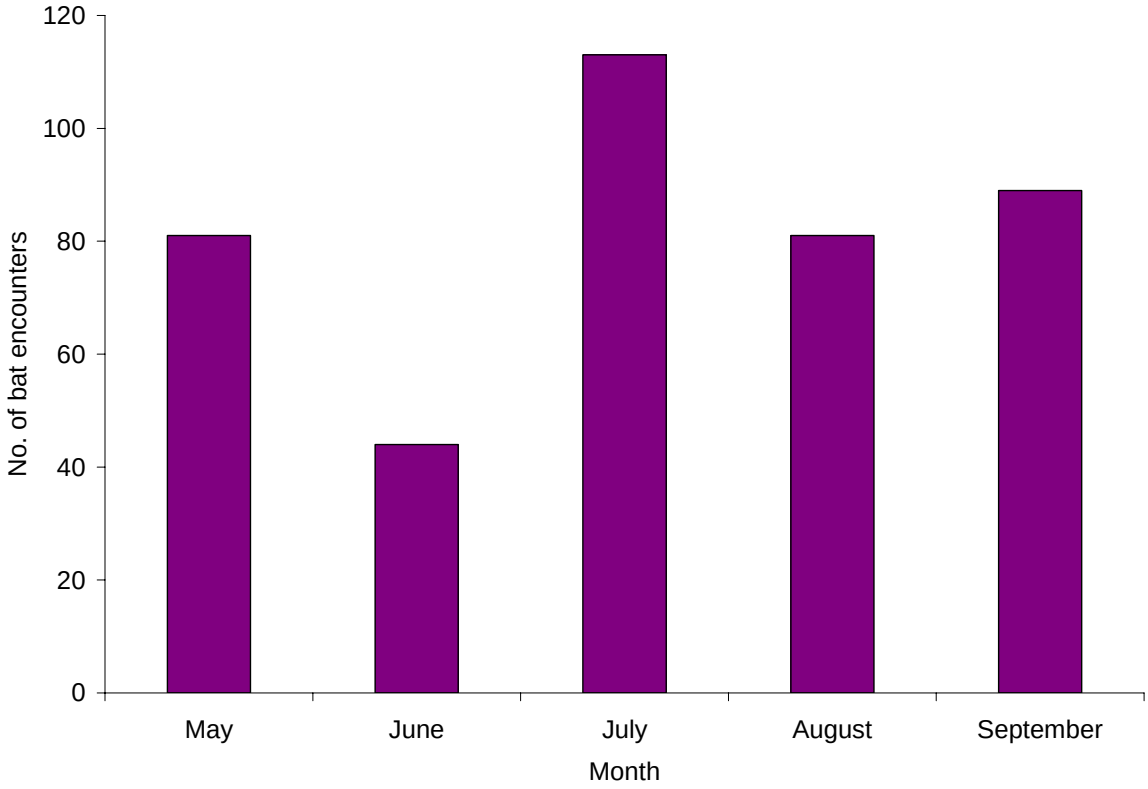

Figure 22. Monthly variation in total bat encounters on the Isle of Wight for survey block SZ3575.

Having the same transect surveyed each month allows a comparison of seasonal bat activity. All species were grouped together (but note that no noctules, Leisler's and very few soprano pipistrelles were recorded in the Isle of Wight). June shows markedly fewer encounters compared with other months and highest encounter rates were in July.

4.3.6.4 Variation in echolocation call peak frequency of pipistrelles

To investigate whether there were differences in the peak echolocation frequency for common and soprano pipistrelles between geographical areas sonogram analysers were asked to record the peak frequency of the echolocation calls of the pipistrelle bats that they identified.

The mean peak frequency of the echolocation calls of the soprano pipistrelle for England, Scotland and Wales (with standard deviations) was 55.3 (2.3), 55.2 (2.2) and 55.3 (2.3) respectively. The mean peak frequency of the echolocation calls of the common pipistrelle for England, Scotland and Wales (with standard deviations) was 45.7 (1.4), 45.4 (1.6) and 45.7 (1.5) respectively. However, there was no apparent difference in peak frequency of common pipistrelle or soprano pipistrelle echolocation calls between Wales, England and Scotland. The overall peak frequency of the echolocation calls of the soprano pipistrelle was 55.2 (2.3) and the overall peak frequency of the echolocation calls of the common pipistrelle was 45.7 (1.4) (Figure 23).

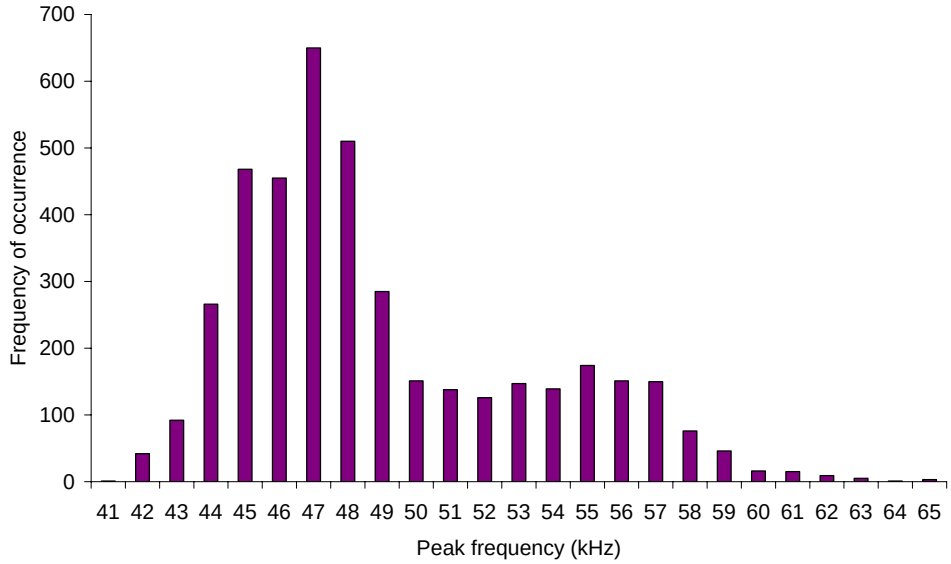

Figure 23. Peak echolocation call frequencies of soprano and common pipistrelles

4.4 Terrestrial Mammals

A total of 399 mammals were encountered along transect routes. Of these, 65 were dead. Details of all mammal encounters are presented in Table 4 in Appendix 3. There was a wide variety of mammals species/groups encountered with the most abundant being rabbits, bats and foxes followed by hedgehogs, mice hares and badgers (Table 2). More than five time as many live mammals were observed as dead ones.

Table 2. Total encounters and encounter rate for mammals observed along transect routes.

Mammals	No. Alive	No. Dead	Alive (per km)	Dead (per km)
hedgehog	15	5	0.004313	0.001438
mole	0	1	0	0.000288
bat	68	0	0.019554	0
rabbit	129	38	0.037095	0.010927
hare	9	1	0.002588	0.000288
squirrel	0	8	0	0.0023
shrew	4	0	0.00115	0
field vole	2	0	0.000575	0
bank vole	1	0	0.000288	0
vole	2	0	0.000575	0
wood mouse	6	1	0.001725	0.000288
mouse	11	1	0.003163	0.000288
rat	5	1	0.001438	0.000288
fox	50	4	0.014378	0.00115
badger	9	1	0.002013	0.000288
mink	2	0	0.000575	0
stoat	1	0	0.000288	0
pole cat	1	0	0.000288	0
deer	2	0	0.000575	0
roe deer	4	0	0.00115	0
unknown	7	4	0.002013	0.00115
Grand	**334**	**65**	**0.096043**	**0.018691**

Total

There was sufficient data to investigate seasonal variation in fox and rabbit encounters.

Seasonal variation in the number of fox encounters

The objective here was to test whether fox encounters varied with survey month. The mean number of fox encounters (dead and alive) was calculated for each month (Figure 24).

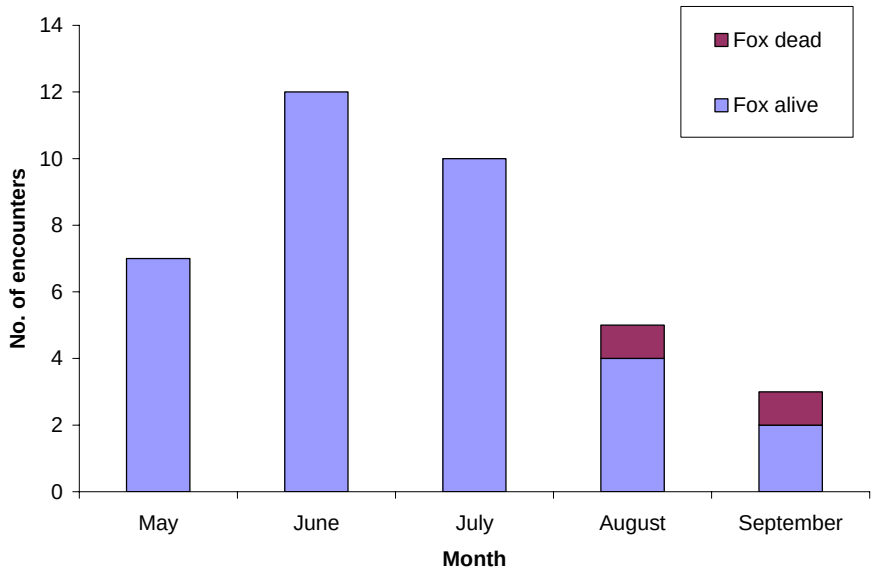

Figure 24. Overall monthly fox encounters

Fox encounters peaked in June and then gradually decreased from July until reaching the lowest encounter rate during September.

Seasonal variation in the number of rabbit encounters

The objective here was to test whether rabbit encounters varied with survey month. The mean number of rabbit encounters (dead and alive) was calculated for each month (Figure 25).

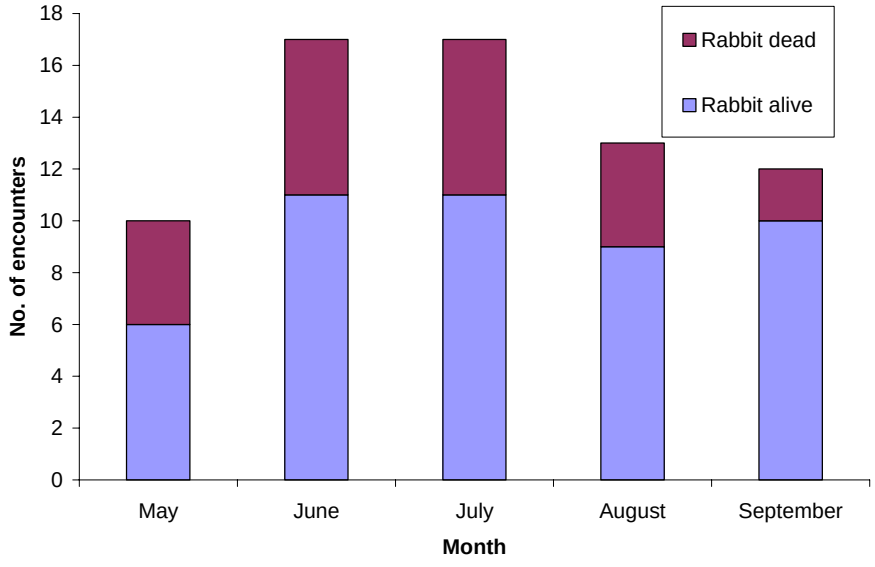

Figure 25. Overall monthly rabbit encounters

The lowest number of rabbit encounters overall was in May with peak encounters occurring in June and July.

Encounter rates and Environmental Conditions

All statistical tests between number of fox or rabbit encounters and climatic variables were not significant.

4.5 Other observations

As well as mammals, twelve owls were observed along encounter routes and details of these are included in Table 7 in Appendix 3.

4.6 Georeferenced Data

Each mammal record was georeferenced (Figure 24).

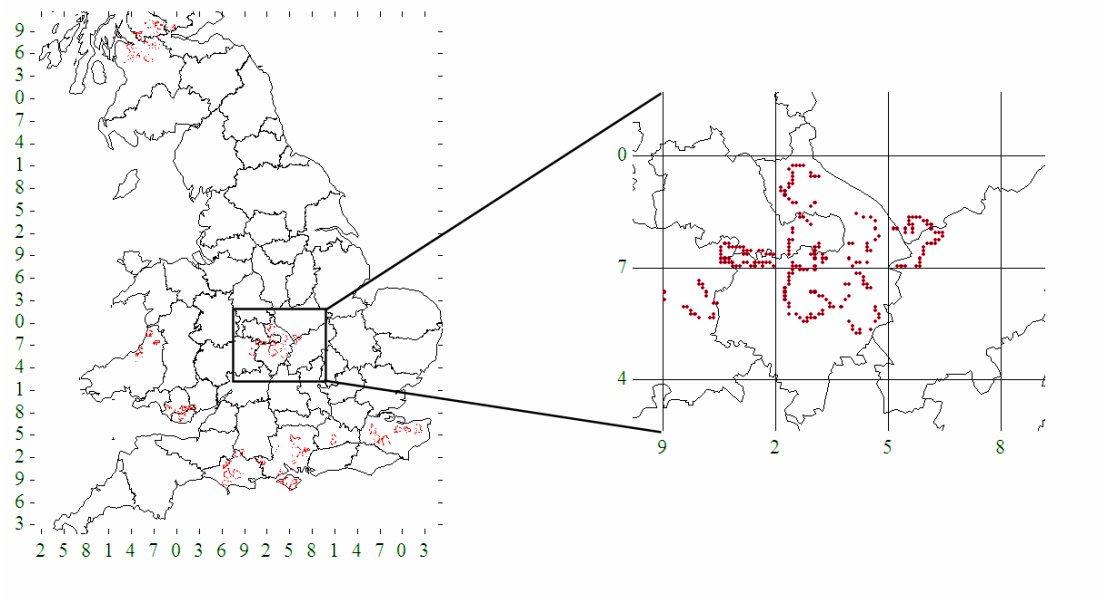

Figure 24. Distribution of Bats & Roadside Mammals Survey 2005 mammal records with enlarged view of Warwickshire.

ITE Land Classes

ITE Land Classes were identified for each species record. A summary of bat records and ITE land classes is presented in Table 8 in Appendix 3. There was insufficient data for analysis to be carried out for each ITE land class.

Environmental Zones

The ITE land classes can be combined to form Environmental Zones:

1 – Lowland arable in England/Wales – **Easterly lowlands**
2 – Lowland pastural in England/Wales – **Westerly lowlands**
3 – **Uplands** in England/Wales

4 – **Lowlands** in Scotland
5 – Marginal uplands in Scotland – **Intermediate & Islands**
6 – True uplands in Scotland - **Highlands**

There was insufficient data to carry out analysis for each individual mammal species other than bats based on Environmental Zones. However, a summary of Environmental Zones and mammal species is presented in Appendix 3 (Table 9).

Although it was not possible to classify the entire routes travelled according to Environmental Zone, we were able to make comparisons between the proportions of encounters of bat species occurring within each Environmental Zone

Proportion of each bat species encounters occurring in Environmental Zones

The proportion of occurrences of each bat species varied between Environmental Zones (Figure 25). For each species, the greatest proportion of encounters occurred in the Easterly lowlands (lowland arable in England/Wales) and the Westerly lowlands (lowland pastural in England/Wales), with the exception of the soprano pipistrelle, which had the highest proportion of encounters in the Lowlands in Scotland.

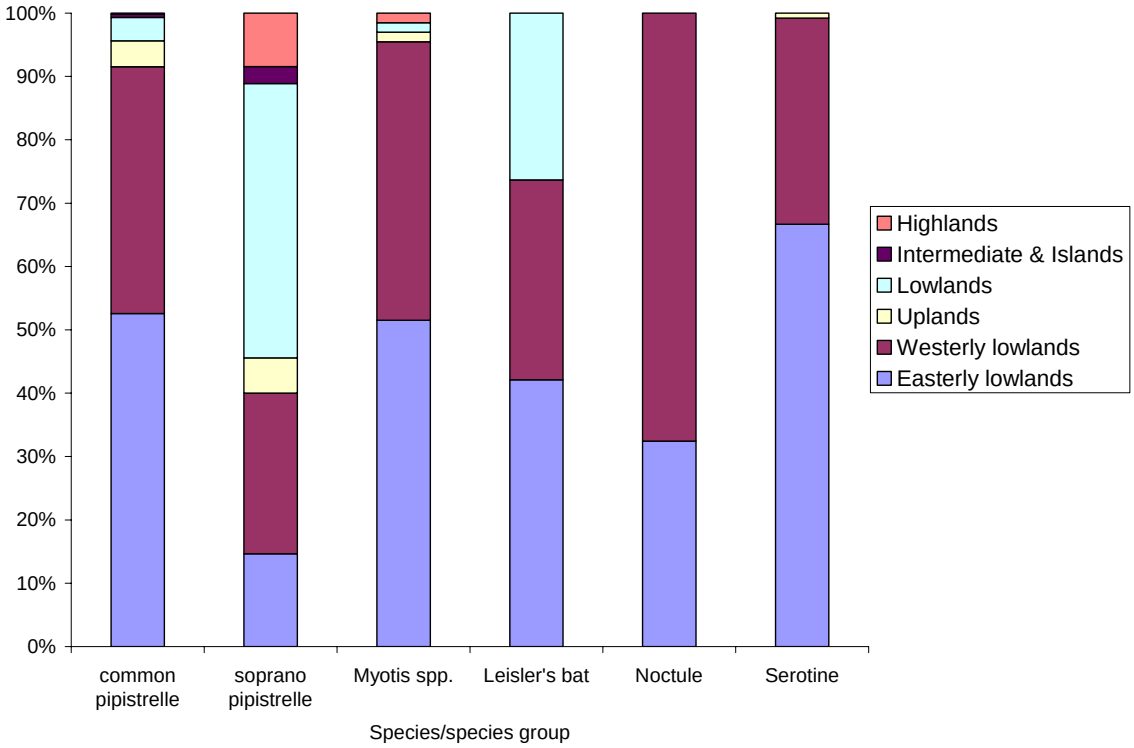

Figure 25. Proportions of encounters of each species/species groups occurring in each Environmental Zone.

Proportion of common and soprano pipistrelles occurring within each Environmental Zone

Generally, there was a decrease in the proportion of common pipistrelle encounters and an increase in soprano pipistrelle records across Environmental Zones with a greater proportion of common pipistrelles occurring in the Easterly lowlands (lowland arable in England/Wales) and a greater proportion of soprano pipistrelles occurring in the Highlands (Figure 26).

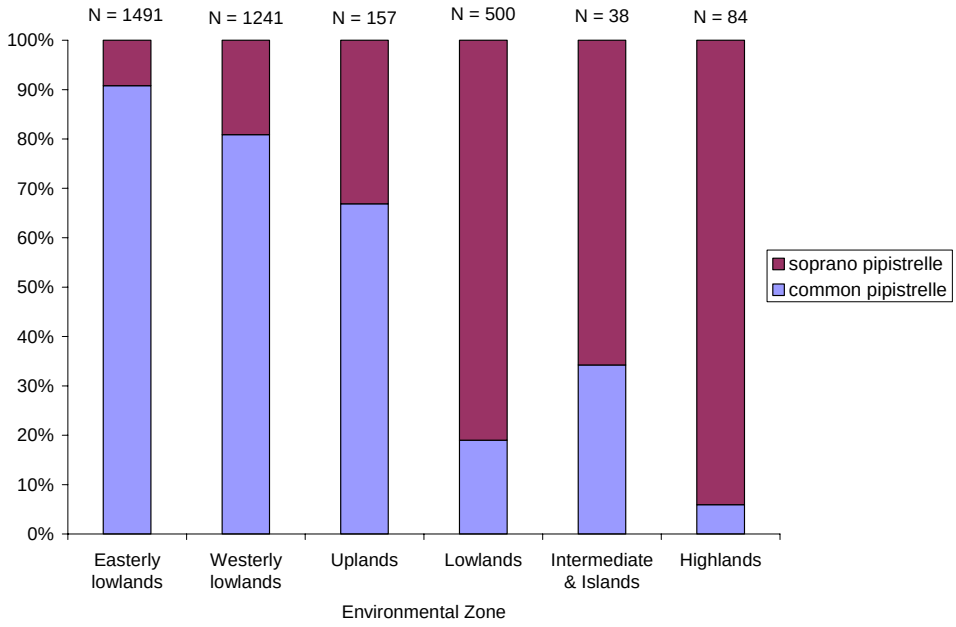

Figure 26. Proportions of common and soprano pipistrelles occurring within Environmental Zones

Proportion of *Myotis* spp., serotines, noctules and Leisler's bats occurring in Environmental Zones

Although *Myotis* spp., noctules and Leisler's bats were encountered within all Environmental Zones with the exception of the Intermediate & Islands (marginal uplands of Scotland), by far the most records were encountered in the Easterly lowlands (lowland arable in England/Wales) and the westerly lowlands (lowland pastural in England/Wales) and therefore these are most suitable for comparison. The proportion of *Myotis* spp and Leisler's bat were similar between the Easterly lowlands and the Westerly lowlands (Figure 27). However, for serotines and noctules, there was a greater proportion of serotines in the Easterly lowlands and a greater proportion of noctules in the Westerly lowlands.

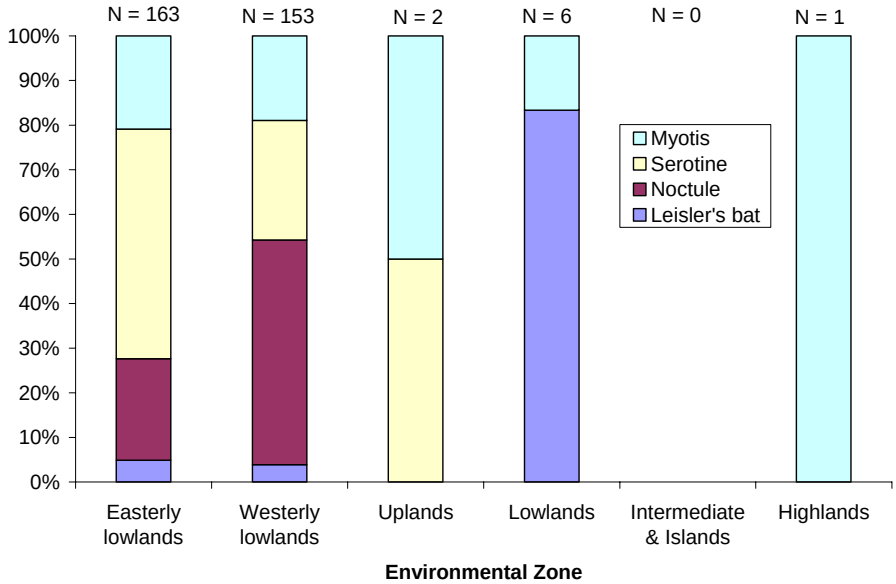

Figure 27. Proportion of *Myotis* spp., Serotines, noctules and Leisler's bats occurring within Environmental Zones.

5.0 DISCUSSION

Method

The first published paper on (heterodyne) car-based surveying was published in 1987 (Judes 1987). Subsequent (heterodyne) car-based surveys have been carried out by Rydell et al. (1994) and Russ et al. (2003). Daytime, terrestrial roadside mammal surveys have been carried out by the Mammals Trust UK (MTUK) since 2001. The Bat Conservation Trust worked with the Irish Heritage Council to refine the approach and used time-expansion detectors to deliver an Irish National bat monitoring project (Catto et al. 2004) and the method was further refined on this project through use of Global Positioning Systems (GPS) to geo-reference records. The use of the Personal Data Assistant (PDA) with digital 1:50000 maps enabled surveyors to record the exact route driven and to orientate themselves quickly and efficiently at night. The approach of simultaneously surveying for bats and other mammals provides the most complete mammal survey that delivers on aspirations of the Tracking Mammals Partnership.

Overall, the method proved reliable and delivered a substantial amount of records in a short space of time. Volunteers were able to implement the methods and the use of the GPS/PDA system together with the software program written by Martin Newman made geo-referencing of records quick and simple. However technology is changing all the time and where new technology will improve the survey it should be considered.

Recommendation: the core methodology should be used in future but where technological advances in equipment or software could improve the method they should be used. In such instances care should be taken to ensure monitoring data is not affected.

In the present survey the time expansion detector was set to sample ultrasound for 320 ms before slowing the captured sound. This approach worked well for pipistrelle and *Myotis* spp as they have distinctive echolocation calls that can be identified with confidence from a single call. The larger bats; serotines, noctules and Leisler's, have less distinctive calls and identification is easier when a sequence of calls is recorded. However as the larger bats have slow repetition rates usually only 1 or 2 calls were recorded and this made identification more difficult. Using a sample period of 1 200 ms on the detector would result in more calls, from the same bat, being recorded and facilitate easier identification of large bats.

Recommendation: Consider using a sample period of 1 200ms on future surveys

Dataset generated

This is a novel, cost-effective project that has delivered a substantial, quality-assured mammal roadside dataset, in a single summer season with trained volunteer surveyors. Specifically, it has delivered 4 719 new bat records and 399 terrestrial mammal records all geo-referenced to 20-200 metres.

This project surveyed for live (and dead) mammals along roads at night and used time expansion bat detectors with post-survey sonogram analysis to identify bat species on a large scale. The approach of surveying from vehicles allowed 50 km of road to be surveyed on each survey night and this compares favourable with 3 km generated on foot surveys.

Survey participants, of all ages and survey experience, made a positive contribution to mammalian conservation and also appreciated viewing live mammals in their natural environment.

In the longer term this dataset will be used to inform climate change models, determine key roadside habitats that are beneficial to mammalian biodiversity and identify large scale distributional changes.

Bat activity

Overall Species Comparisons

As in line with expectations common and soprano pipistrelle bats were by far the most frequent bat species encountered. However significant numbers of noctules, serotine and *Myotis* species were encountered. In addition new records of Nathusius's pipistrelle and Leisler's bat, which have never been surveyed systematically previously, were obtained highlighting the true scarcity of these species.

Comparison of common and soprano pipistrelle distributions revealed that the common pipistrelle is more abundant in the UK than soprano pipistrelles. However the soprano pipistrelle clearly predominates in Scotland compared with England and Wales. Previous work by Vaughan et al. 1997 showed the soprano to prefer wetland areas and we would predict from our results that Central Scotland and Clyde are wetter than England & Wales. Interestingly, results from North Ceredigion, one of the wetter parts of England and Wales shows a higher proportion of soprano to common pipistrelles than any of the other England/Wales survey areas.

Within night variation

For all bat species (grouped), the second and third survey periods (75 to 135 mins post sunset) coincided with peak bat encounters. This pattern was certainly followed by common and soprano pipistrelle bats but the fact that other species showed different patterns *e.g.* noctules were most frequently encountered in the first quarter (45-75 mins) and *Myotis* in the third quarter (105 – 135 mins) demonstrates there is no optimum period for all species. However as the last quarter (135 – 165 mins) never coincided with a peak of activity of any species this is the time period that could be dropped if necessary.

Recommendation: Keep start time at 45 mins post sunset and consider reducing survey time to 90 mins

Seasonal variation

For all bats there was a difference in encounter rate and month. June showed the lowest encounter rate and July/August the highest. However inter-species differences were observed. Interestingly, common and soprano pipistrelle bat encounters showed markedly different monthly encounters and the drivers behind these differences are not known at present. This is the first time that this has been looked at on this scale and more research is required to identify drivers of these differences. Annual surveys would help provide data on the influence of seasonal weather patterns on species monthly encounter rates.

Recommendation: Keep surveying period as May - September

Baseline data for long-term monitoring

Only 5 of the 10 bat groups carried out an additional monitoring transect in July/August, probably due to the large number of other surveys that are carried out during this busy period. See Volunteer Effort section earlier.

The aim of the monitoring transects was to set up a long-term local and regional monitoring project for bat species. At present, the National Bat Monitoring Programme delivers this at a UK/country level but the car survey method can deliver local monitoring as more data can be collected with a few surveyors. These surveys should then compliment each other and deliver the aspiration of local bat volunteers. Clearly, one year's data is insufficient to analyse the robustness of monitoring conclusions. However, previous work in the Republic of Ireland demonstrated the efficacy of the car monitoring method to deliver robust monitoring for common pipistrelles, soprano pipistrelles and Leisler's bat. At this stage we feel there is no reason why it should not work additionally for noctules and serotines.

Recommendation: Ensure monitoring transects are surveyed twice annually in July/August

The Isle of Wight

The fact that the Isle of Wight could only carry out two transects as a result of the size of the island allowed an opportunity for monthly surveying of the same transect. Comparing repeat surveys of the same transects provided a more robust analysis of monthly variation in bat encounters (the effect of

surveying different transects is removed). Comparison of activity patterns of the Isle of Wight and the rest of the UK showed similar results indicating that the 'seasonality' effect is not influenced by surveying different transects.

Recommendation: The Isle of Wight should continue to take part in the project

Peak frequencies of the echolocation calls of common and soprano pipistrelles

There were no regional differences in the peak frequency of echolocation calls between common and soprano pipistrelles. In a previous smaller scale study looking at peak frequencies of pipistrelle bats emerging from roosts, Jones & van Parijs (1993) found that there were no regional differences and this work supports their findings.

Recommendation: Keep checking pipistrelle peak frequencies in other parts of the UK

Mammals

Volunteers enjoyed recording terrestrial mammals (especially the live ones!) and as the majority of volunteers were from Bat Groups this helped to broaden their interest in wider mammalian conservation. Through surveying transects in subsequent years it will be possible to identify 'hotspots' of dead mammals where poor road design is resulting in mammal casualties.

Recommendation: Continue to record mammals, produce more mammal conservation material to the volunteers and increase the number and distribution of survey areas.

Comparison between terrestrial mammal species

Although foxes and rabbits were by far the most encountered mammals along survey routes, the large variety of other mammal species encountered demonstrate how useful the survey technique is for investigating large scale mammalian diversity. The majority of the mammal species encountered (81%) were alive which is in contrast to other road surveys which only count dead mammals. This provides an ideal opportunity for volunteers to observe live mammals in the wild.

Data from this survey should complement data derived from the MTUK's diurnal Mammal Roadside Survey and, one analysis of their results have been completed we recommend comparing encounter rates and seasonal patterns of encounters between the two surveys.

Seasonal Variation in fox and rabbit encounters

For rabbits, mating occurs throughout the year, although the majority of litters are born between February and August with peak pregnancies during April and June (MacDonald & Barrett 1993). Population numbers have been shown to increase from March/April towards a peak in September/October (MacDonald & Barrett, 1993). It is probable that our observation that rabbit numbers peaked in June and July reflect the increase in summer births.

The majority of fox births occur in the March to May period (MacDonald & Barrett 1993) and therefore the observed peak in June in fox encounters are likely to reflect the increase in population numbers as a result the additional individuals to the population.

It is reassuring that the maximum encounter rates of rabbits and foxes follow the seasonal pattern predicted from MacDonald and Barrett's (1993) studies as it suggests that encounter rates on the car survey are reflecting actual population changes.

Other interesting observations

There were significant numbers of owl species recorded along routes. In addition, some Bat Groups recorded domestic cats. It would be useful to collect records of these nocturnal predators.

Recommendation: Continue to record owl and cat encounters along routes

Georeferenced Data

The use of the GPS/PDA system allowed accurate geo-referencing of mammal records and this made a significant improvement on previous car-based surveys. The fact that volunteers could see the route they followed being plotted out on the PDA's 1:50 000 digital map made nocturnal navigation much easier and was welcomed by the volunteers.

The advantage of having records geo-referenced is that the effect of land use on encounter rates can be assessed *e.g* .the influence of Land Classes / Environmental Zones on encounter rates. With more time, it will be possible to identify the effect of roadside habitats on mammal encounter rates and this will help provide understanding of how roadside habitats influence mammal populations.

Recommendation: We recommend continuing to use the GPS/PDA system on future surveys.

Conclusions

1. Considerably increase the present number of bat/mammal records through implementing a cost-effective mammal survey method and develop a system to ensure such records are available to land managers.

This project has delivered over 5 000 new mammal records and once the dataset has been placed on the NBN it will be available to all.

2. Develop a long-term method for monitoring populations for selected species at the local and regional levels.

The encounter rate of common and soprano pipistrelles, serotines, noctules, Leisler's, Myotis spp, foxes, rabbits (badgers, hedgehogs) appears sufficient for long term monitoring.

3. Collect data systematically to enable future identification of road designs and roadside features that impact on mammal populations.

Through annual surveying it will be possible to identify locations where dead mammals occur regularly and this will prompt an investigation as to how the road design is contributing to these casualties. Similarly, identification of locations associated with high abundances of live mammals will help inform beneficial mammal road designs.

Recommendation: A PhD student at University of East Anglia has expressed an interest in analysing mammal records using GIS. Data should be made available to her for analysis

4. Inform road managers of the impact 'their' roads have on roadside mammal populations.

Once analysis in 3) above has been completed results should be presented in a leaflet that is made available to Highways managers and road designers.

6.0 RECOMMENDATIONS

1. ***Recommendation: the core methodology should be used in future but where technological advances in equipment or software could improve the method they should be used. In such instances care should be taken to ensure monitoring data is not affected.***

2. ***Recommendation: Consider using a sample period of 1 200ms on future surveys***

3. ***Recommendation: Keep start time at 45 mins post sunset and consider reducing survey time to 90 mins***

4. ***Recommendation: Keep surveying period as May - September***

5. ***Recommendation: Ensure monitoring transects are surveyed twice annually in July/August***

6. ***Recommendation: The Isle of Wight should continue to take part in the project***

7. ***Recommendation: Keep checking pipistrelle peak frequencies in other parts of the UK***

8. ***Recommendation: Continue to record mammals, produce more mammal conservation material to the volunteers and increase the number and distribution of survey areas.***

9. ***Recommendation: Continue to record owl and cat encounters along routes***

10. ***Recommendation: We recommend continuing to use the GPS/PDA system on future surveys.***

11. ***Recommendation: A PhD student at University of East Anglia as expressed an interest in analysing mammal records using GIS. Data should be made available to her for analysis***

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Bats and Roadside Mammals Survey
SURVEY PROTOCOL

Thank you for volunteering to take part in this exciting new project! The Bats and Roadside Mammals Survey is a joint initiative between **The Bat Conservation Trust** and **Mammals Trust UK**.

PROJECT SUMMARY

OBJECTIVE?
To carry out systematic night-time road surveys for bats and other mammals using a car driven transect.

HOW?
The surveys themselves will take place from a moving vehicle driven at 15mph for two hours and covering up to 50km (approx. 30 miles) of single carriageway roads per night. The bat recordings will be collected by attaching a time expansion bat detector to the rear window of a car. Other mammal sightings will be noted by the surveyors when spotted. The use of a portable PDA (handheld computer) linked to a GPS mapping system will enable accurate geo-referencing of records and identify routes driven.

WHEN?
The evening surveys will be carried out from the start of May to the end of September 2005.

WHERE?
Groups will be asked to survey two different routes per month of approximately 30 miles in length over the 5-month study period. In addition, one of the routes surveyed in July will be repeated in August to provide baseline monitoring data. (Total = 11 surveys) We have sub-divided counties into survey blocks and each route should fit into a single block where possible.

WHO CAN TAKE PART?
As no previous experience is required, the survey is open to everyone. Some training will be provided to help identify mammals spotted along the road and an illustrated information booklet will be provided to all volunteers. Training will also be given on the use of GPS/PDA and on the use of a minidisk recorder.

EQUIPMENT NEEDED?
A time expansion bat detector, minidisc recorder, GPS/PDA unit, clamp and leads and a flashing beacon.

WHAT WILL BE THE OUTCOMES OF YOUR EFFORT?
1. Considerably increase the present number of bat/mammal records in your area.
2. Provide baseline data for the relative abundance of many mammal species and establish a method for reliably monitoring mammal populations at your county level.
3. Establish a database of roadside bat and other mammal records that will inform the planning process and road managers of the impact that roads have on mammal populations. In addition it will provide them with the knowledge to identify, and subsequently enhance, road design and roadside features that have a detrimental affect on mammal populations.
4. Monitor potential influx of new bat species into UK as a result of climate change.

WHEN WILL WE SEE RESULTS?
A full report will be produced and circulated by January 2006 and sent to all participants. All records collected will be made available to MTUK, BCT, Bat Groups and the NBN.

IMPORTANT NOTICE

The BCT/MTUK partnership values its volunteers and depends upon them for performing their charitable work. As a volunteer, you are under no obligation to carry out whatever work is assigned to you, and you may cease acting as a volunteer at any time. Nor is BCT BCT/MTUK partnership obliged to offer you any work. The work you do is unpaid, and you are not an employee of BCT BCT/MTUK. The BCT/MTUK will endeavour to provide you with information and guidelines about certain risks to health and safety associated with your work of which it is aware. But the BCT and MTUK are small charities with limited resources. Consequently it is not able to provide you with information about all risks to health and safety or training on health and safety; nor is it in a position to supervise your work or to instruct you how to do it. As general advice, BCT strongly advises you not to undertake any activity if you have any concerns about risks to your own or others' health and safety, and at all times to take the utmost care of your own and others' health and safety. If you become aware of any particular risks associated with the work you do, we would be grateful to be informed of these.

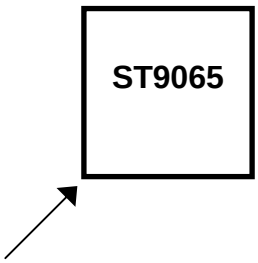
EQUIPMENT LIST

- SURVEY & MONITORING BLOCK DETAILS sheet – to record block information e.g. date, block name.
- RECORDING SHEET to record details during each survey e.g. weather, survey events – mammals encountered etc.
- List of SUNSET TIMES
- Map of your area showing SURVEY BLOCKS
- A minidisk recorder
- GPS/PDA unit with car connecting kit and 2 memory cards
- 2 blank mini discs
- Directional window clamp to hold the bat detector
- Tranquility or Pettersson D240x Time Expansion bat detector
- Minidisk-bat detector connecting lead
- Maps – 1:50 000 OS maps to plan your route
- Spare batteries
- Clip board
- Torch (a head torch leaves hands free to write)
- Pencils
- Flashing orange beacon
- Thermometer
- It might be useful to bring the number of a local wildlife rescue centre in case you come across any injured animals

1. PLANNING AND PREPARING FOR THE SURVEY

Survey Blocks

You have been given a map of your local area which has been divided into 15km² blocks. The code within each block refers to the grid reference of the south-westerly corner and this code will be used to identify each survey block.



Timetable

- Each group will be asked to survey **ten** different blocks, **two** in each of the months of **May**, **June**, **July**, **August** and **September**.

- In addition to surveying the ten survey blocks, the group will be asked to select **one** of the blocks surveyed in July to repeat in August.

	Survey Blocks		
May	✓	✓	
June	✓	✓	
July	✓	✓	
August	✓	✓	✓
September	✓	✓	

Repeat

Total = 11 surveys

Planning your route

Once you have chosen your survey block, using a 1:50 000 map you should plan a **30 mile** long route that covers as much of the block as possible. On a 1:50 000 map (e.g. OS Landranger), 30 miles is represented by a piece of string cut to 95 cm or 37.5 inches. Try and keep your transect inside the block as much as possible, but don't worry if you have to travel into the adjacent block occasionally. Try to avoid transects on major roads as you will be driving quite slowly. The route should minimise backtracking unless unavoidable. We recommend that the route should not start under dense cover so that the GPS has a clear line with the satellites.

SURVEY CHECKPOINT: On the 1:50 000 map, identify an easily identifiable landscape feature that occurs **somewhere along the first 5 miles** of your route (e.g. a T-junction, church, start of bridge). You will be asked to record information as you drive past this feature during the survey to ensure that the GPS data is synchronised with the minidisk time data.

Notes/Troubleshooting:

➔Although it's possible to simply drive from a start point for 30 miles without planning we strongly recommend that you plan your route beforehand in order to aid navigation and maximise block coverage.

Familiarise yourself with the GPS/PDA unit

If you have received your GPS/PDA from BCT it should be fully set up for use. IF YOU RECEIVED IT FROM A SHOP IT NEEDS TO BE SENT TO BCT AS SOON AS POSSIBLE. Important information is contained within the manual provided by the manufacturer and we recommend familiarising yourself with the following sections:

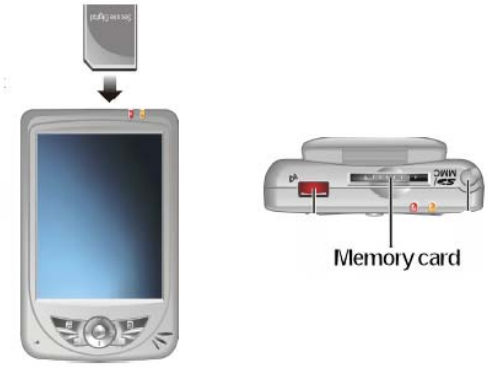
- Hardware feature – Pages 1-4
- Connecting to AC Power and Charging battery – Page 7
- Basic Skills – Page 12-13

Inserting and removing a Memory Card

The memory card contains all the map data and the GPS data from the survey routes you have completed.

When the GPS unit is off the memory card can be removed by slightly pushing in the top edge of the card to release it and then pulling it out of the slot.

To insert a memory card, simply push it fully into the slot until it clicks in place.

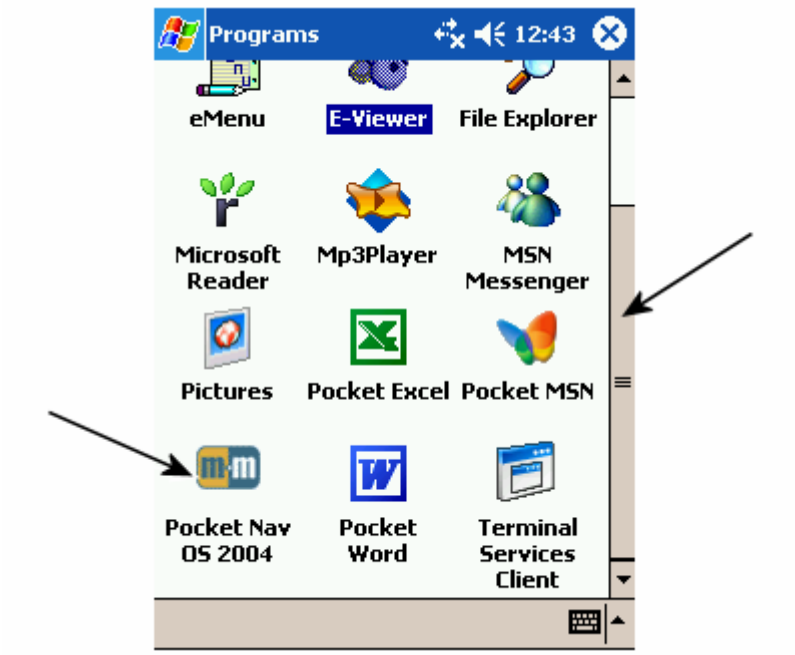


Notes/Troubleshooting:

When using the PDA/GPS pull up the GPS receiver into the horizontal position.

Familiarise yourself with the Memory Map software

1. Opening the Memory Map software



Open the Memory-Map OS program by tapping on **Start** at the top-left of the screen and the tapping on **Programs**. The adjacent screen should pop up.

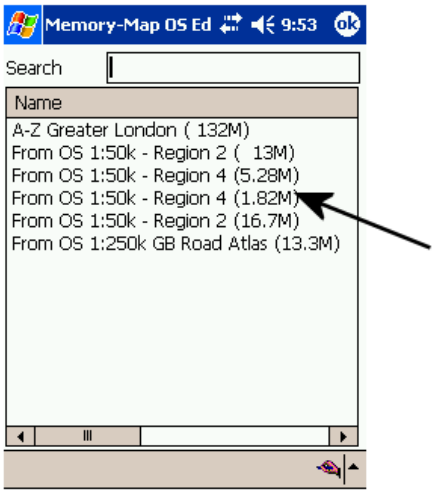
To select the required program, tap on **Pocket Nav OS 2004**.

Notes/Troubleshooting:

➔If the **Pocket Nav OS 2004 icon** is not visible it might be necessary to scroll down by tapping on the bar at the right hand side of the screen.

2. Loading a Map.

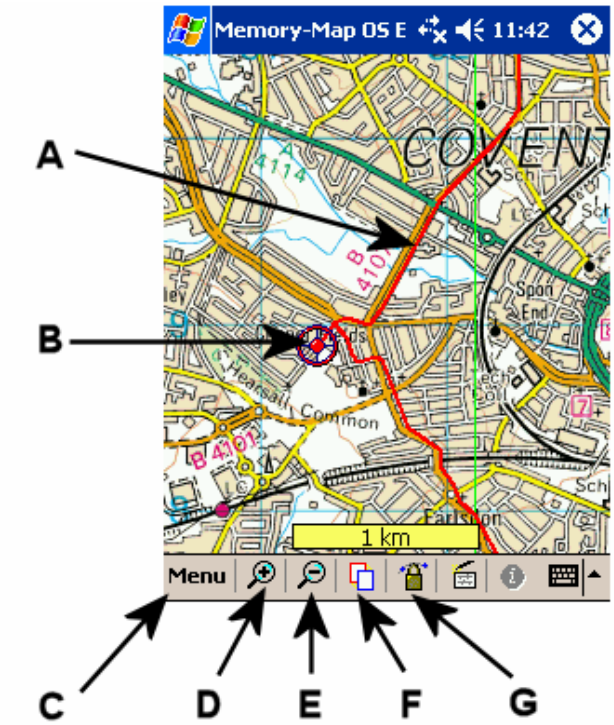
Tap on the **Menu** button (C) and then on the item called **Map…..**


Memory-Map OS Ed
9:53
ok
Search
Name
A-Z Greater London (132M)
From OS 1:50k - Region 2 (13M)
From OS 1:50k - Region 4 (5.28M)
From OS 1:50k - Region 4 (1.82M)
From OS 1:50k - Region 2 (16.7M)
From OS 1:250k GB Road Atlas (13.3M)

…and
a new box pops up. This lists all the maps within your area. Each map covers a single 15km² block. Tap on one of the listed maps and click **ok** (top right corner). If the map that loads is not the one you want simply go through the process again and select a different map.

3. The Memory Map Window

We recommend familiarising yourself with the following items:



A. The route that you have travelled is usually represented as a red solid line
B. The point at which you are located at the present time is represented by a red circle with a flashing red spot in the centre. IF THE CIRCLE IS WHITE AND NOT FLASHING THE DEVICE HAS NOT YET MANAGED TO LOCATE YOUR POSITION.
C. The MENU containing a list of options and settings
D. Click here to 'zoom in'
E. Click here to 'zoom out'
F. Click here to toggle between the current view and the entire map
G. Clicking here locks your location so that the map is displayed in the window with your current location in the centre at all times.

4. Zooming and Fixing Your Location. You can zoom in and out of the map by using the zoom functions (**D**, **E** and **F**). To ensure that your location is always fixed in the centre of the screen click the padlock icon (**G**).

Notes/Troubleshooting:

➔If the screen goes blank just tap on the screen to bring it back to life.

➔If the menu at the bottom of the screen disappears, tap once (or sometimes twice) on the green icon in the bottom left hand side of the display

➔On rare occasions the GPS/PDA unit may 'freeze up' and you will not be able to do anything. **DO NOT CLICK THE RESET BUTTON ON THE BACK OF THE MACHINE OR THE UNIT WILL NEED TO BE RETURNED TO BCT.** This problem can usually be solved by either waiting or pressing the Power button on the left hand side of the unit (See Manual – Page 3). If this still doesn't work, you can close the program by doing the following: Press one of the front buttons on the PDA; tap on **Start** (or **Tasks**) in the top left hand corner and select **Settings**; tap on **System** at the bottom of the screen and selecting the **Remove Programs** icon; tap on the tiny blue word '**memory**' at the bottom of the screen; click the tab marked '**Running Programs**' and select the button marked '**Stop All**'. Then open **Memory Map** again by clicking on **Start** in the top left hand corner. You can then start again.

Testing the minidisk and detector

It is important to determine that the time-expanded sound from the detector is being recorded correctly to the minidisk. To do this set up the minidisk and bat detector as outlined in the sections below (“Setting up the detector” and “Setting up the minidisk recorder”). Turn both devices on and press record on the minidisk. Record a few seconds while jingling a set of keys in front of the detector microphone. Play back the section you’ve recorded to ensure that you can hear the slowed down sound of the keys (it should sound like a steamroller running over a group of bell-ringers).

Safety

Your safety is the overwhelming priority. One person should be assigned to drive and the other should carry out the recording/navigation. THE ASSIGNED DRIVER SHOULD ONLY DRIVE AND THEIR FULL ATTENTION SHOULD BE ON THE ROAD AT ALL TIMES.

Attach the flashing beacon to your car following the manufacturer’s instructions. In addition you should attach a large sign to the rear of your vehicle to inform people of what you are doing (e.g. ‘Wildlife Survey’).

Make sure you have a full tank of petrol and inform the Police of your activities. Take a mobile phone to summon help in case you get into difficulties.

Don’t forget to wrap up warm – it can get very cold with the car window open!

When to survey

The surveys take place from May to September. Only survey in good weather *i.e.* temp > 7^0 C, no rain, light wind. The group has been asked to survey a total of 10 different routes, two in each of the months from May to September. In addition, one of the routes surveyed in July should be repeated in August.

Start time

The survey should start **45 minutes** after sunset. Sunset times (corrected for summer time) have been provided.

2. SETTING UP EQUIPMENT IN THE CAR

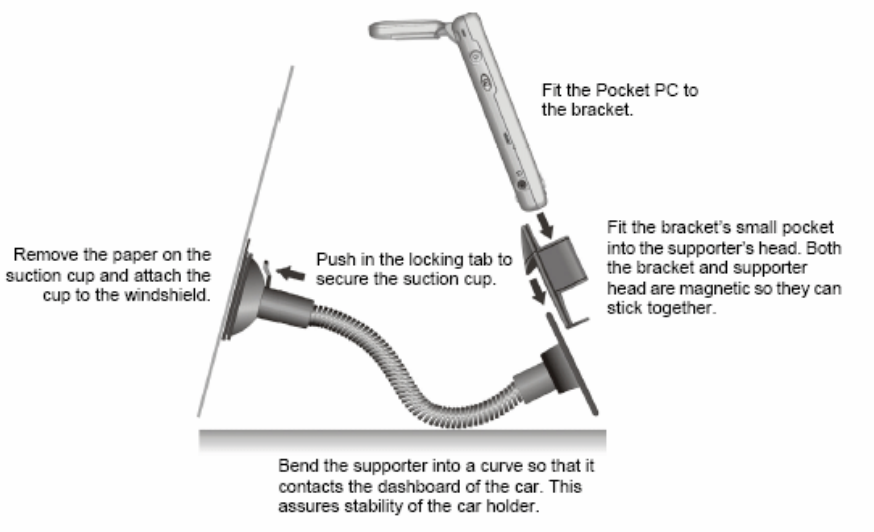
Equipment

Ensure that you have all the equipment, including the survey sheets, from the equipment list.

DON’T FORGET TO CHARGE THE PDA/GPS BATTERY BEFORE USE!

Fixing the PDA inside the car

Fix the GPS/PDA unit to the windscreen following the diagram in the user manual (Page 5). The unit should be fixed to the passenger side of the vehicle – i.e. where the navigator sits.


Fit the Pocket PC to the bracket.
Fit the bracket's small pocket into the supporter's head. Both the bracket and supporter head are magnetic so they can stick together.
Remove the paper on the suction cup and attach the cup to the windshield.
Push in the locking tab to secure the suction cup.
Bend the supporter into a curve so that it contacts the dashboard of the car. This assures stability of the car holder.

Don't forget to raise the GPS unit to the horizontal position as in the diagram.

Although the GPS/PDA battery should last for the duration of each survey, if you have one, the unit should be plugged into the car cigarette light socket using the supplied lead.

Turn on the GPS/PDA unit to receive a signal

Ensure that you have a memory card inserted in the GPS/PDA unit.

Load up the map containing the survey block you are about to survey (see the supplied map of your area showing survey blocks).

IMPORTANT! Remove data recorded by the GPS/PDA from previous surveys by tapping on **Menu-Overlay-Delete All**. This will remove them from the memory.

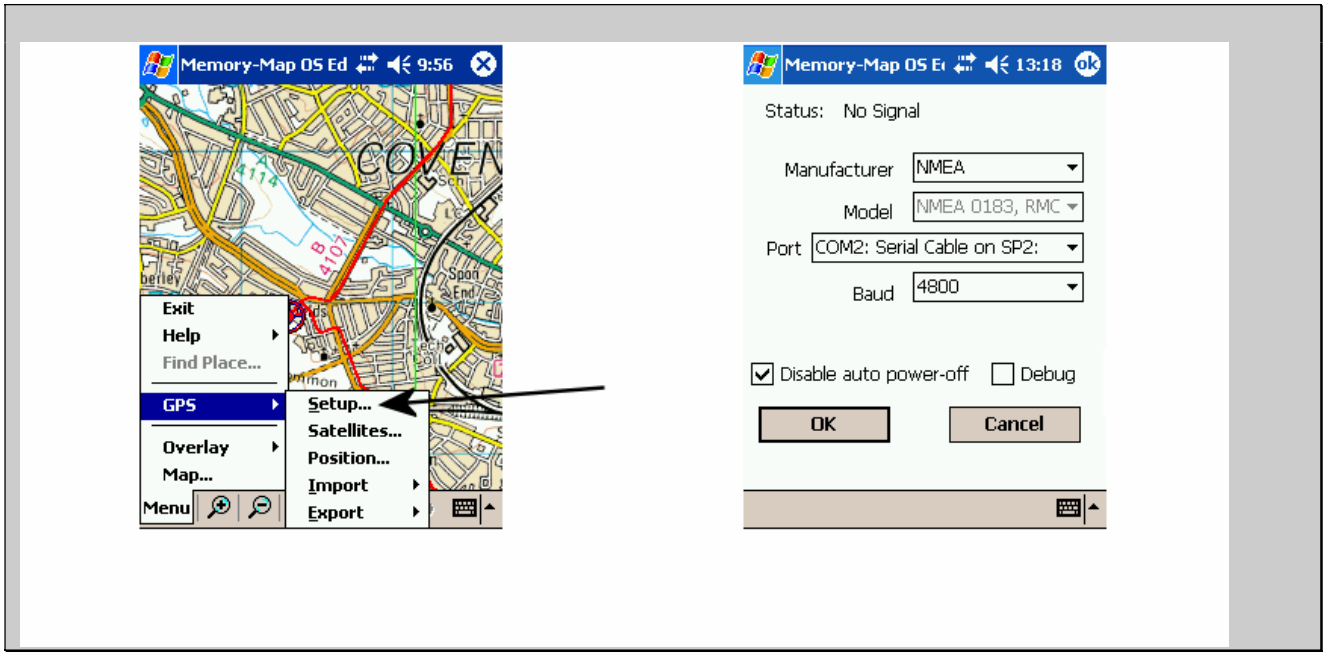
You should have a map with a red circle with a flashing red dot in the middle of it.

Notes/Troubleshooting:

➔If the circle is white with no dot wait for the GPS to detect satellites.

➔If you have no circle at all, try clicking the 'padlock' button at the bottom of the screen to centralise the map around your location.

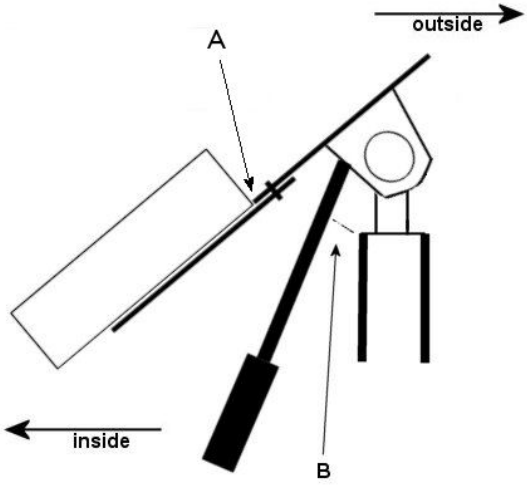
If the problem persists, check the GPS is set up correctly by selecting **Menu-GPS-Setup** and ensuring that '**COM2: Serial Cable on SP2**' is visible in the Port box and '**NMEA**' is visible in the Manufacturer box.

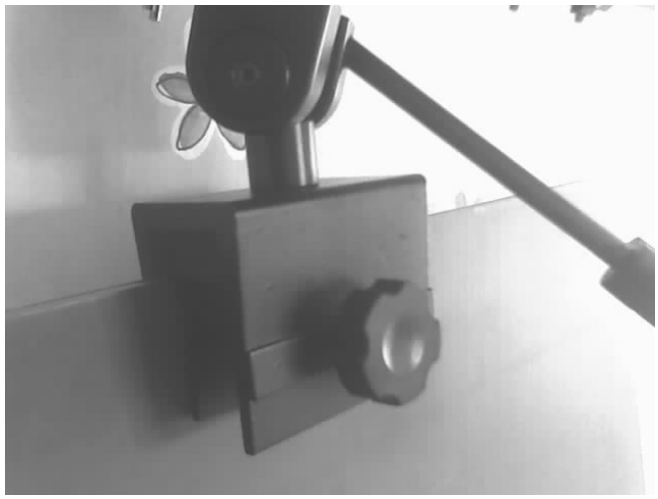


Positioning the bat detector

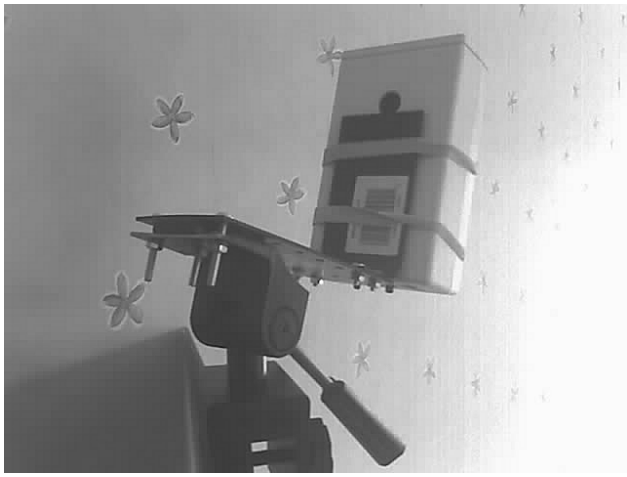
Attach the detector firmly to the car bracket using the provided Velcro strips and two strong elastic bands.

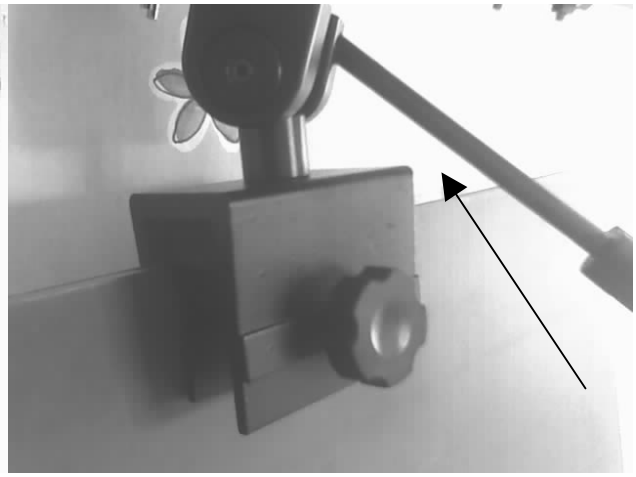
Tranquility II: The front (microphone end) of the detector should be up against the join in the brown seating plate (see diagram, A) and the bracket should be attached firmly to either the front or rear passenger side window (i.e. the one nearest the kerb). The rear passenger window may be preferred to stop the navigator/recorder getting too cold! To set the correct detector angle (10 cm inside the car, pointing upwards and angled towards the rear of the car) touch the metal adjustment handle to the inside right hand side of the mounting bracket, then lift it up by 1cm (see diagram at 'B'). This should maximise detection of bats and minimise wind interference.





Tranquility Transect: The microphone is located on the top of the machine. Therefore a window clamp with a right-angled bracket is required (see diagram). Attacht eh detector to the back of the bracket with elastic bands and Velcro so that the microphone is positioned just above the top of the bracket and pointing outwards over the top of the tripod (diagram). The bracket should be attached firmly to either the front or rear passenger side window (i.e. the one nearest the kerb). The rear passenger window may be preferred to stop the navigator/recorder getting too cold! To set the correct detector angle (10 cm inside the car, pointing upwards and angled towards the rear of the car) touch the metal adjustment handle to the inside right hand side of the mounting bracket, then lift it up by 1cm (see diagram at 'B'). This should maximise detection of bats and minimise wind interference.





Setting up the detector

Attach the lead from the TAPE (or REC) socket of the detector to the LINE IN socket of the recorder. Install a fresh set of batteries into the detector. Turn the detector on and set the time expansion function to 320ms. Turn the SENS knob fully clockwise – at this setting the time expansion will be triggering constantly. If the detector has a time expansion option (i.e. x10, x32), this should be set to **x10**.

Setting up the minidisk recorder

A new dry cell battery should be installed before every survey. Insert a new, blank disc. The recording mode should be set to MONO. If the option is available the recording volume should be set to AUTOMATIC. A small headtorch is essential for seeing the recorder but do not distract the driver whilst it is on.

You have been provided with an in-car cassette adaptor. If you wish to listen to the time expansion recordings (and therefore bats) while driving, plug the cassette adaptor into the car cassette recorder and the into the headphone/line out socket of the minidisk. This will also enable you to assess whether the equipment is functioning correctly.

3. STARTING THE SURVEY

At this point, all the equipment should be in place, all maps and survey sheets are readily available, the flashing beacon is on the roof and the driver is ready to go! To start the survey:

1. Turn on the PDA/GPS, open Memory Map, and wait for a signal which should take a couple of minutes. You can check you have a signal by tapping on **Menu-GPS-Position**. If there is no signal the menu item '**Position**' will be greyed out and it will not be possible to tap on it.

2. On the **Recording** Sheet fill in the surveyor's name (specifying who the driver is), date of survey and the Block Code. Also record temperature, cloud cover and wind speed but leave the start time blank. An example recording sheet is included.

3. Set the car trip meter to zero (if you don't have a trip meter then record the exact mileage at the start).

4. Turn on the flashing beacon

5. Turn on the detector

6. **Finally, start driving away and AT THE SAME TIME press record on the minidisk and take a note of the start time (including seconds).**

Try to keep at a constant speed of **15mph**

Occasionally, it will be necessary to increase your speed, for example when crossing dual carriageways, railway lines etc.. However, please note that we have been advised by the police that it is not legal to have a flashing orange beacon on the car at speeds over 25mph.

4. DURING THE SURVEY

As you progress, the route you have travelled should appear as a solid red line on the GPS/PDA map.

Notes/Troubleshooting:

➔If your route does not appear, try a) setting up the GPS (see **Turn on GPS/PDA unit to receive a signal** above) or b) Waiting a few minutes to see if the GPS needs to locate satellites (Note that if you begin your transect in dense cover, such as woodland, the GPS will have a lot of trouble locating you. Try starting elsewhere).

➔If you find that your location drifts off the visible area of the map try clicking the padlock icon (G).

➔If you take a wrong turn – don't panic! Either backtrack or choose an alternative route to intercept with your original route. It is much more important to keep going at a steady pace than spend a lot of time trying to find your original route. The GPS/PDA should give you an idea of where you are – just tap on the screen for your present location!

Recording information during the survey

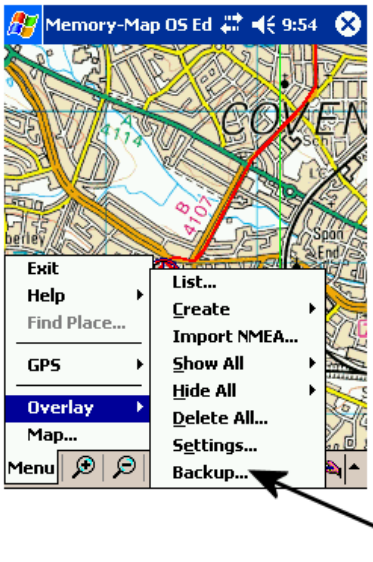
- **SURVEY CHECKPOINT:** At the survey checkpoint you identified when planning your route take a note of the time (using your watch), the elapsed time on the minidisk recorder and a description of your checkpoint feature (e.g. T-junction by Post Office) and record the information on the **Recording Sheet**. This will help us relate the minidisk recordings to the GPS data after the survey.
- Record the exact time the route started and ended.
- Record the trip mileage for the start and end of the route
- Record wild mammals encountered during the route (e.g. foxes, rabbits, hares, deer, hedgehogs, badgers etc). **However, please do not stop the car to identify mammals!** Mammals that are observed dead should be written in brackets. (e.g. a **live** mammal = **deer**, a **dead** mammal = **(deer)**). Also record any other 'interesting' observations. All observations should include the time at which they occurred and the distance from the start (as determined by reading the trip meter)
- Take a note of problems that have occurred such as minidisk skipping, flat batteries etc.

5. FINISHING THE SURVEY

At the end of the survey, write your name, survey date and Block Code on the minidisk and fill in the details on the **Survey and Monitoring Block Details Sheet** (which contains information for all of the groups' surveys).

Saving the data at the end of your route

When you have finished your route it is essential that you backup or save the data collected by the GPS. To do this tap on **Menu-Overlay-Backup….**



Name: Choose a name for the backup which includes the date (6 figures - ddmmyy) and the Block Code (e.g. 120505**ST8560**)

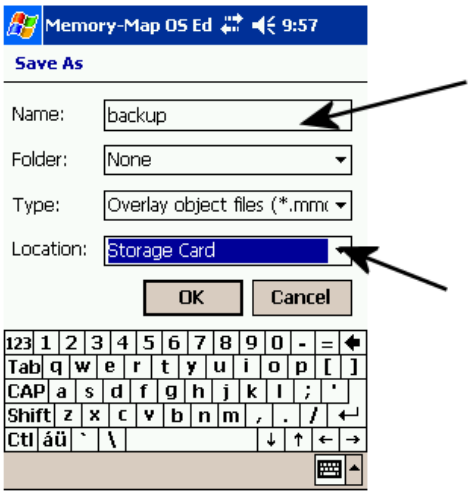
You can enter numbers and letters by tapping the relevant buttons. To delete click on the **black solid left pointing arrow** at the top left hand corner of the keyboard. If you cannot find the keyboard see Notes.

Folder: Leave this as '**None**'

Type: Leave this as '**Overlay object files (*.mmo)**'

Location: This must be set to '**Storage Card**'

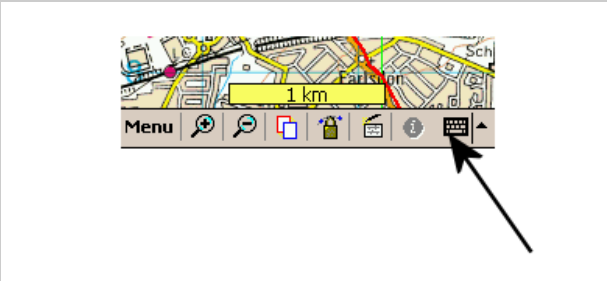
When you have finished click **OK** in the centre of the screen.



NB. If you are worried that it might not have worked simply create another backup with another name (but which includes the block code). Alternatively, you could try and save the file with the same name as before. If "overwrite existing file" pops up you know it has already been saved correctly (and can therefore cancel the overwrite).

Notes/Troubleshooting:

Note: If you do not get the 'keyboard at the bottom of the window you need to tap on the keyboard icon at the bottom right.



Before turning off the GPS/PDA

Once you are sure that you have created a backup of your route tap on **Menu-Delete All** to remove all your work. Your red route should disappear from the map.

DON'T FORGET TO CHARGE YOUR GPS/PDA UNIT BEFORE REUSE! See Manual – Page 7. Connect unit to mains using supplied cable. There is no need to plug the USB cable into the computer.

6. AFTER THE SURVEY

Ensure that the GPS/PDA unit is turned off and remove the memory card. Please send the **memory card**, the **Recording Sheet** from your survey and the minidisk to **Jon Russ** (address below).

Please pass all equipment, information sheets and the **Survey and Monitoring Block Details Sheet** to the next surveyor. If sending all equipment by post, please ensure that it is wrapped carefully to protect it from knocks.

Note: Each group has been provided with two memory cards. While one is in the post/being processed (before being returned) the other one can be used for the next survey.

GOOD LUCK!

For more information about the project please contact the Project Co-ordinator Dr Jon Russ

CONTACTS

Project Coordinator: Jon Russ
Tel 02476 850202
Email: roadsurvey@bats.org.uk

Protocol Notes:

- Bats observed in separate extended snapshots are being treated as separate individuals, even though in some instances the echolocation calls ‘flowing’ from one snapshot to the next are obviously the same individuals
- It’s only necessary to take the peak frequency measurement from the first ‘clear’ echolocation calls within each snapshot.
- It’s not necessary to make a note of every echolocation call found within a snapshot if they appear to be produced by the same individual.

SONOGRAM ANALYSIS

1. EQUIPMENT

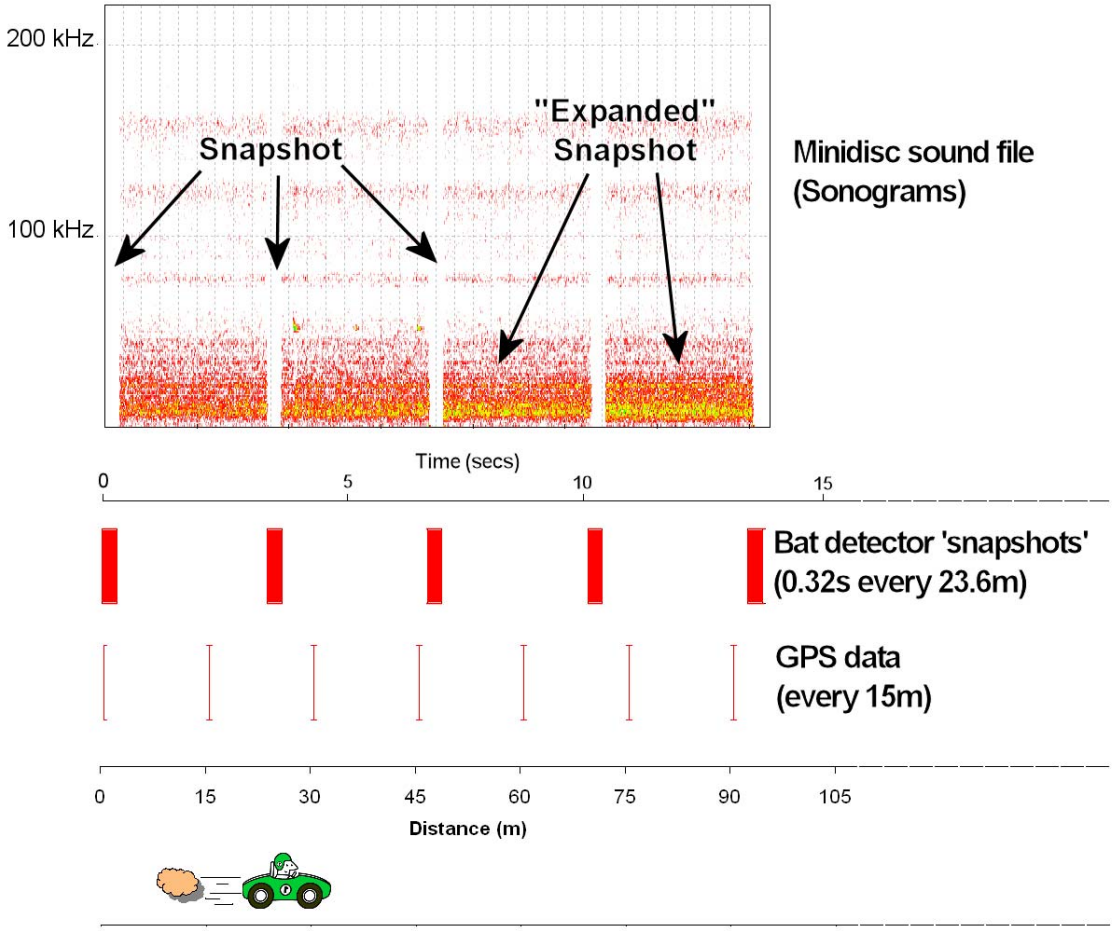
You will need:

a) **BatSound** sound analysis software
b) A **home computer**/laptop with a CD drive

You will be sent:

a) a **CD** containing the sound files from a single survey and an Excel spreadsheet containing the GPS data
b) A **BAT Analysis Sheet**
c) A **MAMMAL Analysis Sheet**

2. BACKGROUND INFORMATION



- The diagram above illustrates the method used during the car survey for recording bats.

- During each car survey a time-expansion bat detector records 0.32s "snapshots" of high frequency sound along the route every 3.5s (approximately). If the car is travelling at 15mph this means that the detector is recording sound every 23.6m.

- After each of these snapshots, the sound recorded during the snapshot is stretched out (time-expanded) by a factor of ten to lower the high frequency sound to frequencies that are audible to humans. This stretched or 'expanded' sound is subsequently recorded onto a minidisk.

- Each route is about 30 miles long which means that each minidisk contains about 2 hours of expanded 'snapshots'.

- In addition to recording high frequency sounds, every 20m a GPS recorder records the **location** (grid reference), **altitude** and **distance from the start** into a data file.

- By comparing the minidisk time to the nearest GPS time the location at which each bat call was heard can be determined.

- To facilitate analysis, the 2 hour minidisk track had been split into manageable 5 minute tracks and transferred to a CD.

- The GPS data file has been transferred to an Excel spreadsheet.

3. SONOGRAM ANALYSIS

Note: Sonogram = Spectrogram

a) Insert the CD into the CD drive

b) Start BatSound

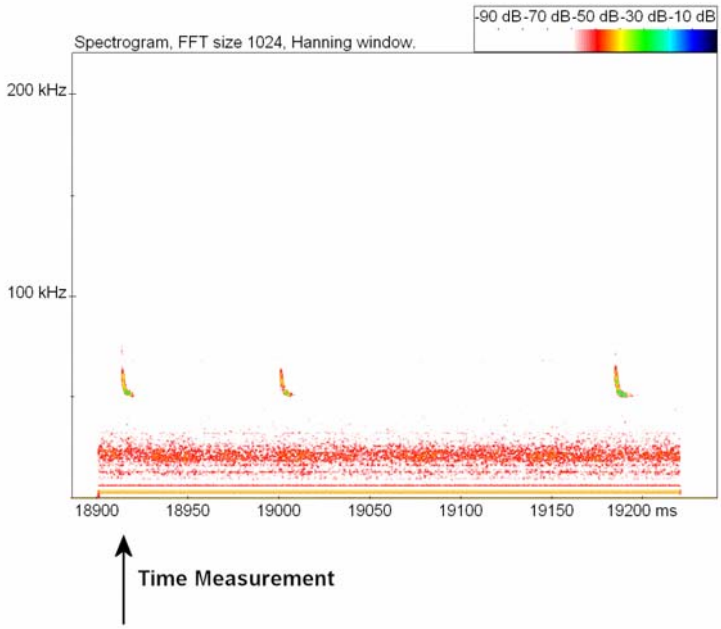
c) Browse to the CD and open the first file (01) in the sequence. The sound files have been labelled sequentially (e.g. 040505SP3570-**01**, 040505SP3570-**02**, 040505SP3570-**03**) and each file or 'track' contains 5 minutes of sound recorded during each survey (-**01** = 0-5 minutes, -**02** = 5-10 minutes etc.). The first part of the file name refers to the survey date and the block code.

d) Change the BatSound settings (see **Appendix A**)

e) You are now going to scroll forward through the sound file by clicking **in front of** the scroll bar at the bottom of the screen until you come across a potential bat call. You can choose the amount of visible 'track time' (i.e. what you can see on the screen). Note, however, that although increasing visible 'track time' means that you will get through the CD a lot quicker, the likelihood of missing a bat will increase. We recommend selecting a single expanded snapshot (approx 350ms) to start with and then increasing this to a maximum of 5 expanded snapshots (approx 1750ms) as your ability to identify a potential bat call improves. You can change the amount of visible time by zooming out (**Tools-Zoom Out**) and zooming in (highlight a section and then **Tools-Zoom In**.

f) When you have identified a potential bat call(s), zoom in to a single expanded 'snapshot' (about 350ms). This will make it easier to compare the call with those presented in the key. Then follow the key in **Appendix B**.

g) Once you have identified the bat echolocation (or social) call make a note of the species on the **BATS analysis sheet**. Include the **track number** (e.g. **01**, **02**, **03**) and the **time** in ms of the call (or if there's a sequence of calls, the first call in the sequence). **Note:** If the settings are correct the **time** should be between **0** and **30000 ms**. Make a note of the peak frequency on the BATS analysis sheet.



h) When you have done this, carry on scrolling through the track.

i) Bat calls in separate expanded 'snapshots' (including adjacent expanded 'snapshots') should be treated as separate individuals and a new entry should be made on the form.

j) When you reach the end of the track, close it and open the next track in the sequence (i.e. if you've just been looking at 040505SP3075-**03** then open 040505SP3075-**04**).

k) Keep going until you finish all the tracks on the CD (there should be approximately 20).

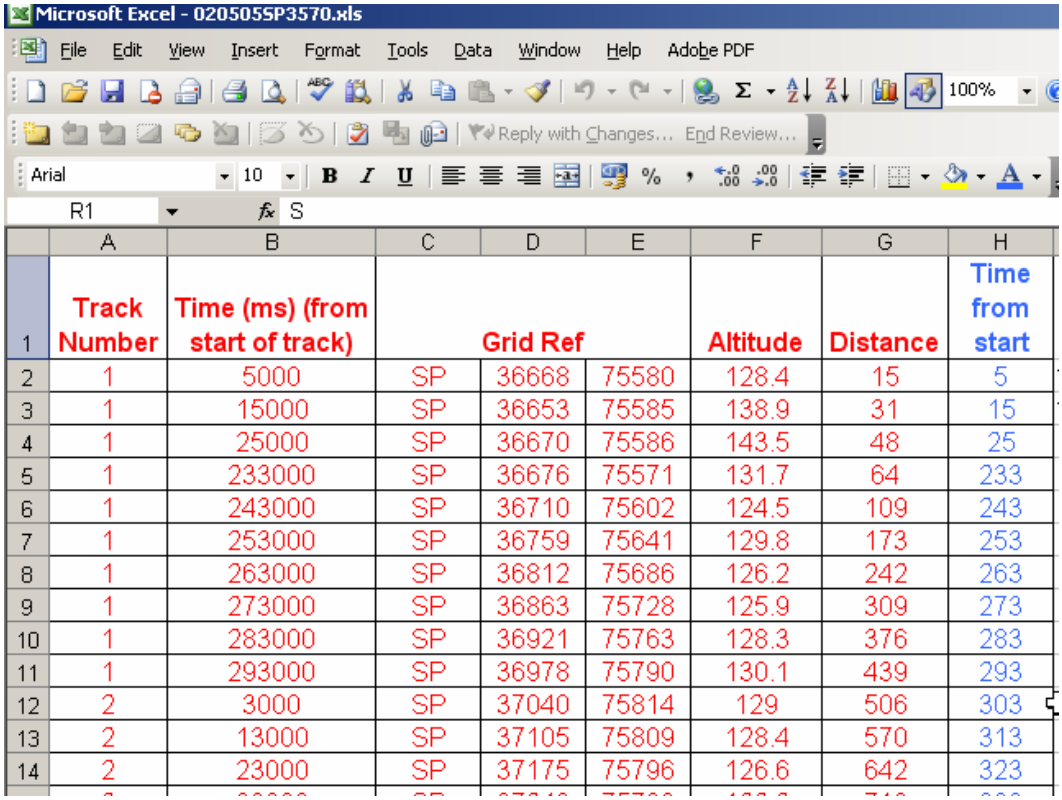
Note: All rarer species (Nathusius, Leisler's, horseshoes etc.) will be checked by BCT.

4. GRID REFERENCES FOR BATS

Once you have analysed the sonograms on the CD you need to identify the grid references for each bat identified:

a) Have your **BATS analysis sheet** to hand and open up the Excel spreadsheet on the CD (e.g. 040505SP3075.xls). **Note:** If you do not have Microsoft EXCEL there is an installation program on each CD to install the EXCEL viewer. On the left hand side there will be a large table in red and blue.

b) To identify the correct grid reference, altitude and distance for your bat call, scroll down to locate the correct **Track Number**, then identify the **Time (ms)** that is closest to the one you have written down for your bat on the **BATS analysis sheet**. For example, if you have identified a common pipistrelle on Track Number 2 at a time of 4000ms, looking at the table below you would scroll down until you reached Track Number 2 in the far left-hand column, then scroll down further until you reach the Time (ms) in the next column that is closest to your figure of 4000ms. In this case it is 3000ms. The grid reference (SP 37040 74814), altitude (129) and distance (506) in this row should then be copied into the relevant row on your **BATS analysis sheet**.


Microsoft Excel - 020505SP3570.xls
File Edit View Insert Format Tools Data Window Help Adobe PDF
Reply with Changes... End Review...
Arial 10
R1
S

	A	B	C	D	E	F	G	H
1	Track Number	Time (ms) (from start of track)	Grid Ref			Altitude	Distance	Time from start
2	1	5000	SP	36668	75580	128.4	15	5
3	1	15000	SP	36653	75585	138.9	31	15
4	1	25000	SP	36670	75586	143.5	48	25
5	1	233000	SP	36676	75571	131.7	64	233
6	1	243000	SP	36710	75602	124.5	109	243
7	1	253000	SP	36759	75641	129.8	173	253
8	1	263000	SP	36812	75686	126.2	242	263
9	1	273000	SP	36863	75728	125.9	309	273
10	1	283000	SP	36921	75763	128.3	376	283
11	1	293000	SP	36978	75790	130.1	439	293
12	2	3000	SP	37040	75814	129	506	303
13	2	13000	SP	37105	75809	128.4	570	313
14	2	23000	SP	37175	75796	126.6	642	323

5. GRID REFERENCES FOR MAMMALS

To identify the correct grid references, altitude and distance for the mammals, refer to the **Mammals Analysis Sheet** which should contain a list of mammals with the time from the start at which they were observed. If you have no mammals on your sheet it means that there were no mammals recorded during the survey and you can skip this step! This time we will be using the **Time from start** in the blue column.

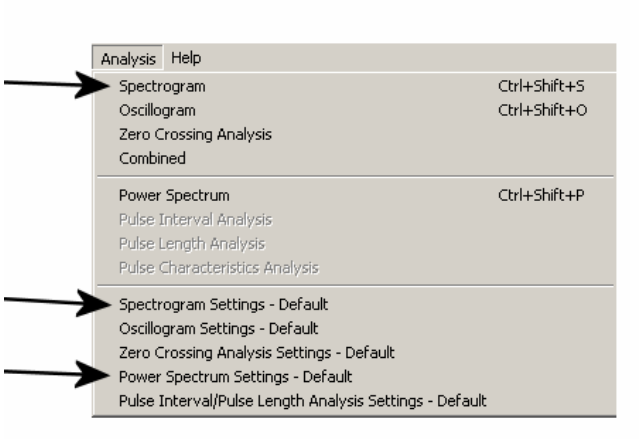
a) Scroll down through the spreadsheet and find the **Time from start** that nearest matches that **Time (s)** written on the **MAMMALS analysis sheet**.
b) Copy the grid reference, altitude and distance data from the same row as the Time (s) into the **MAMMALS analysis sheet**.

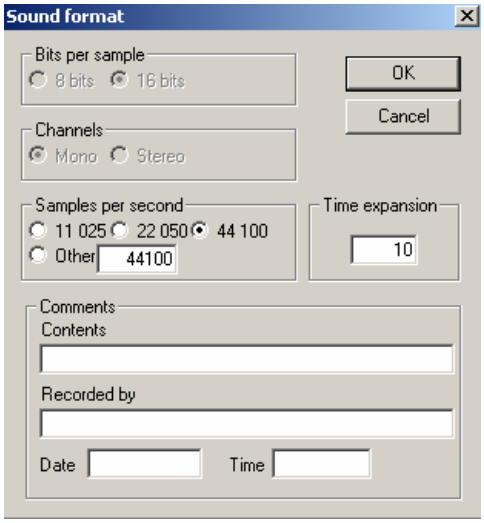
6. FINISHING THE ANALYSIS

Once you have finished the analysis send the **BATS analysis sheet** and the **MAMMALS analysis sheet** back to Jon Russ, 31 Maudslay Road, Chapelfields, Coventry, CV5 8EJ (Email: j.russ@abdn.ac.uk, Tel: 02476850202). Please keep the CD in a safe place as a backup copy for your bat group.

Appendix A: BatSound Settings

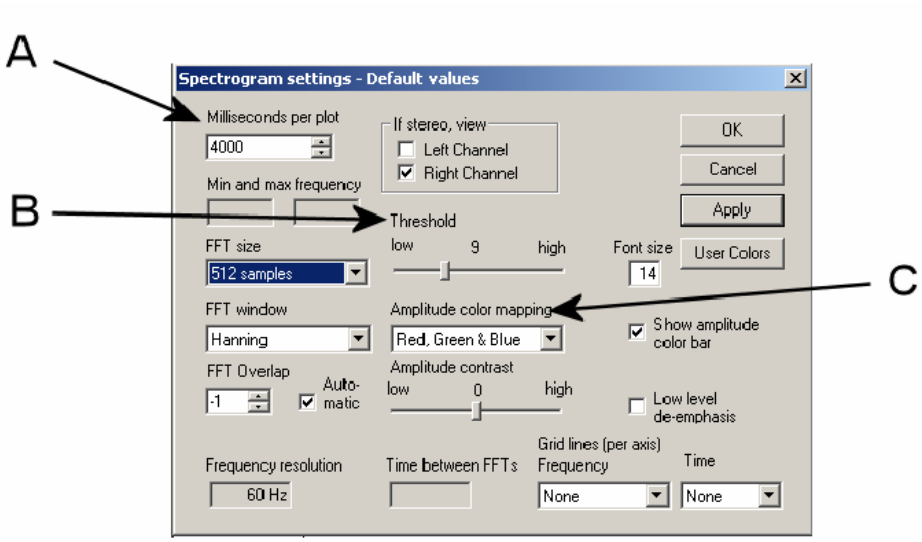
1. **Spectrogram:** If the file did not open as a sonogram select **Analysis-Spectrogram** from the drop-down menu

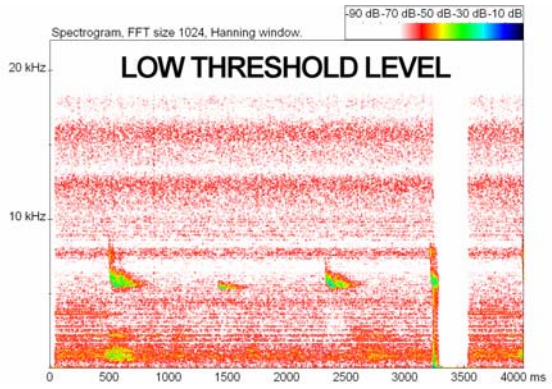


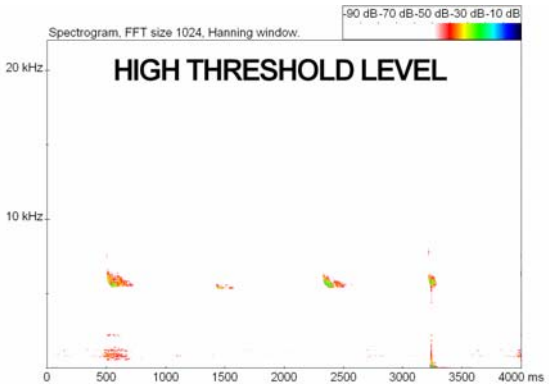


2. **Sound Format:** Then select **Sound-Sound Format** from the drop-down menu and change the Time expansion to '**10**' (see left). Click '**OK**'.

3. **Spectrogram Settings:** Next set up the default Spectrogram settings by selecting **Analysis-Spectrogram Settings (default)** from the drop-down menu. Change the settings so that they appear exactly as in the diagram on the right. Make sure the FFT = 512, However, you can ignore or change **A**, **B** & **C** to anything you like. **B** changes the **threshold level** – i.e. the amount of background noise that you can see. You need to ensure that the separate 'snapshots' are visible.

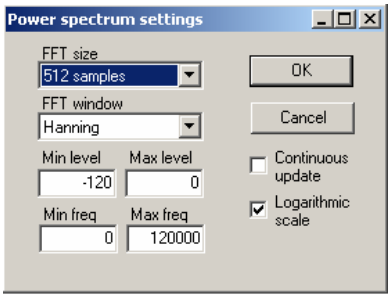






C allows you to select your preferred **colour scheme** – the Red, Green & Blue setting is good! Click '**Apply**' then '**OK**'.

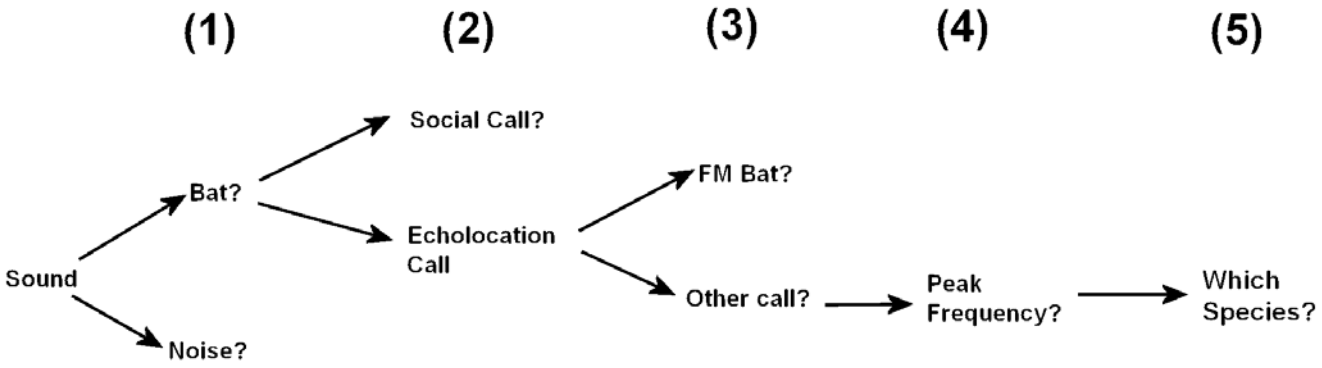
4. **Power Spectrum Settings:** Select **Analysis-Power Spectrum Settings (default)** from the drop-down menu. Change the settings so that they appear exactly as they do in the diagram on the right.



Appendix B: Steps to identification and echolocation key

Note: The example sonograms presented in these steps are the same scale as a single expanded 'snapshot'. The sound files of these sonograms, as well as other examples, are included on the training CD.

Follow the following 5 steps to assess and identify your potential bat call:



(1) Bat or Noise?

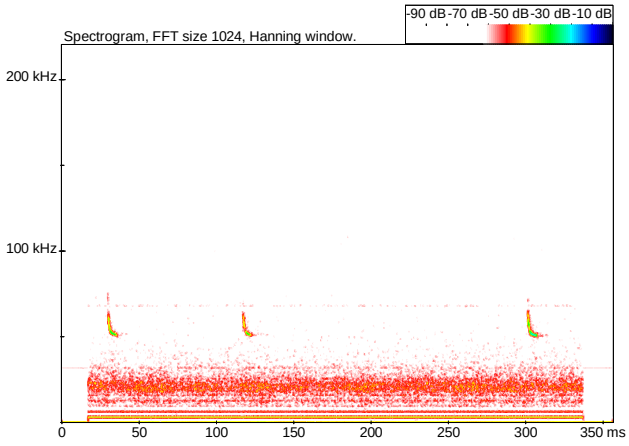
As we are using bat detectors attached to moving cars there will often be a lot of background noise (e.g. wind, mechanical from car etc.). Use the following guidelines and sonograms to help you identify noise.

- The best way to distinguish noise from bat calls is to play the sound. A bat call will be relatively tonal and when played back will sound like a whistle. Noise is highly variable: harsh; very short duration; very long duration; repetitive; hiss; crackle; whining; etc.
- Generally a bat call will be longer than 2.5 ms and shorter than 70 ms.
- Generally bat calls are produced in a sequence (Note, however, that low frequency bat calls (<25 kHz) may only show up singly).

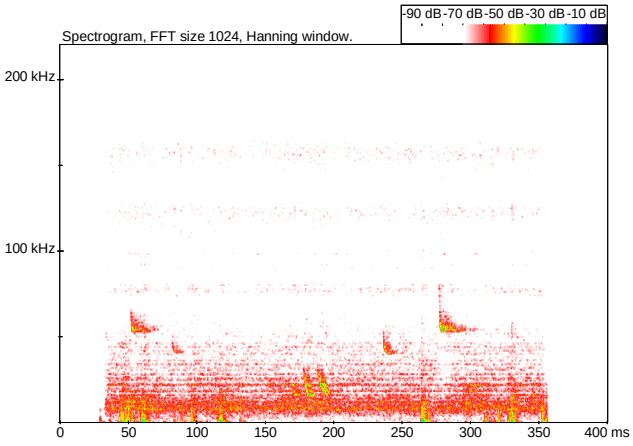
Browse through the sonogram of various noise types and bat calls within this step (1) and also within step (5) to familiarise yourself with the various forms.

Note: The visible 'track time' of the sonograms in this guide are the same as a single expanded snapshot (350 ms).

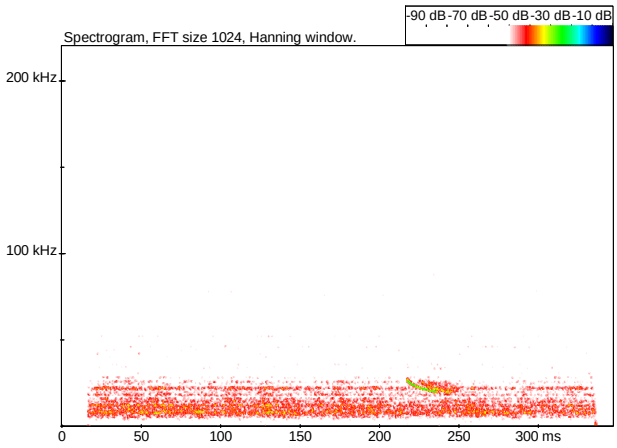
Examples of Bat Calls



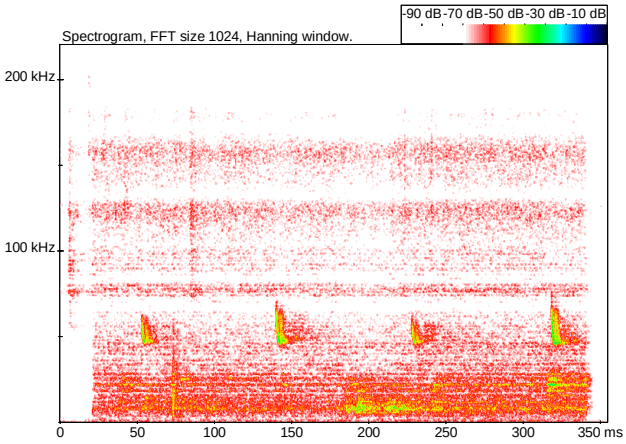
Soprano pipistrelle echolocation calls (one individual)



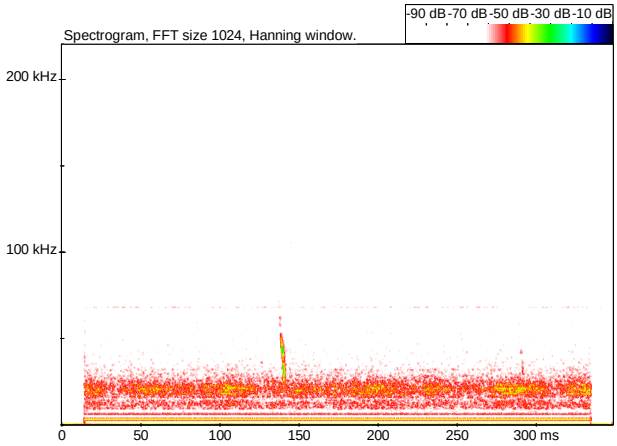
Soprano and common pipistrelle echolocation calls (and social call). One individual of each species



Noctule echolocation call (one individual)



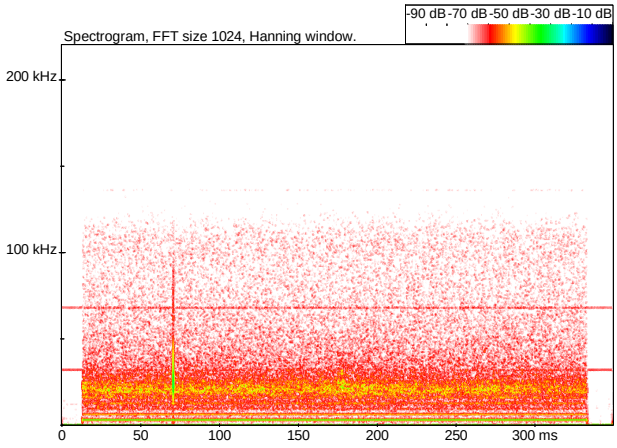
Common pipistrelle echolocation call (one individual)



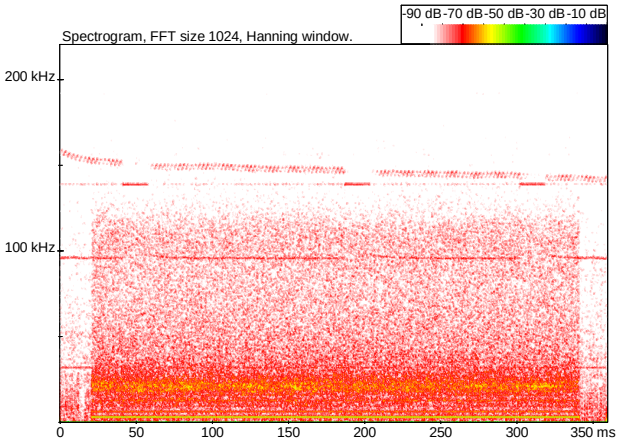
Myotis echolocation call (one individual)

(see the training CD for further examples)

Examples of Noise



'Click'



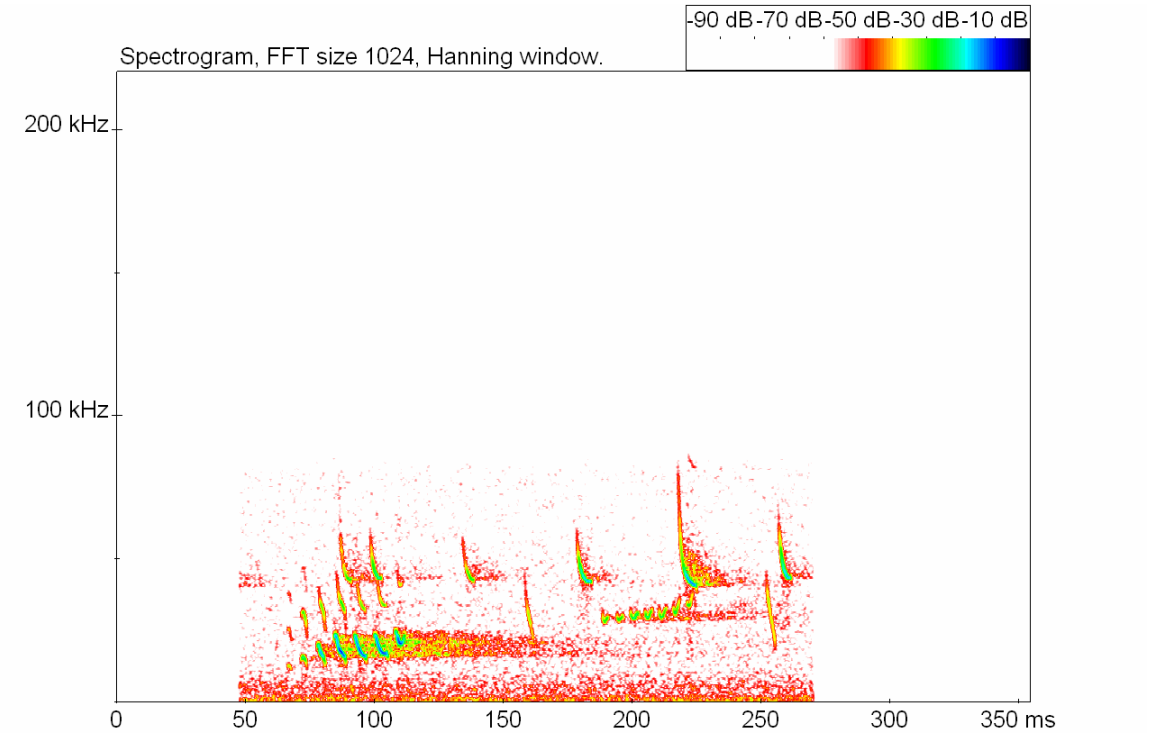
Unknown interference

(see the training CD for further examples)

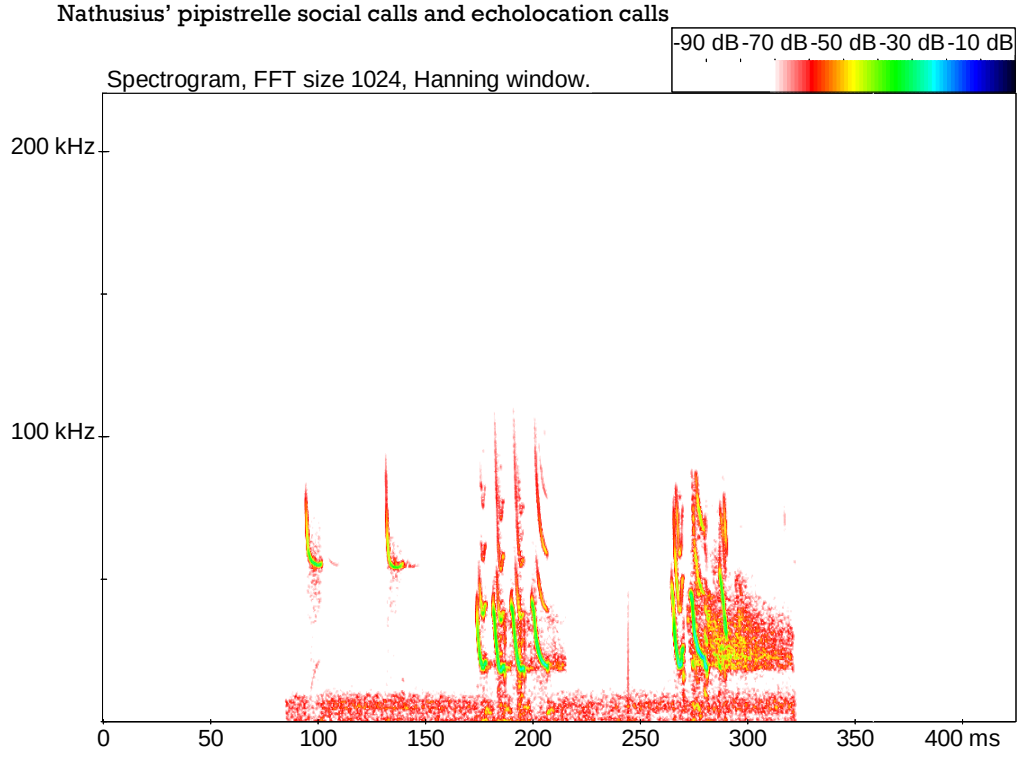
(2) Social Call or Echolocation Call?

Bats produce high frequency social calls as well as echolocation calls. Although social calls are highly variable we are using the following simple guide to identify social calls:

- Social calls usually consist of a series of downward sweeping frequency modulated components – for example every 6 ms.
- The peak frequency of social calls tends to be under 30 kHz
- Echolocation calls consist of a discrete component (although they are produced in a sequence). The most commonly encountered social call will be the pipistrelle social calls (seen here)



Nathusius' pipistrelle social calls and echolocation calls



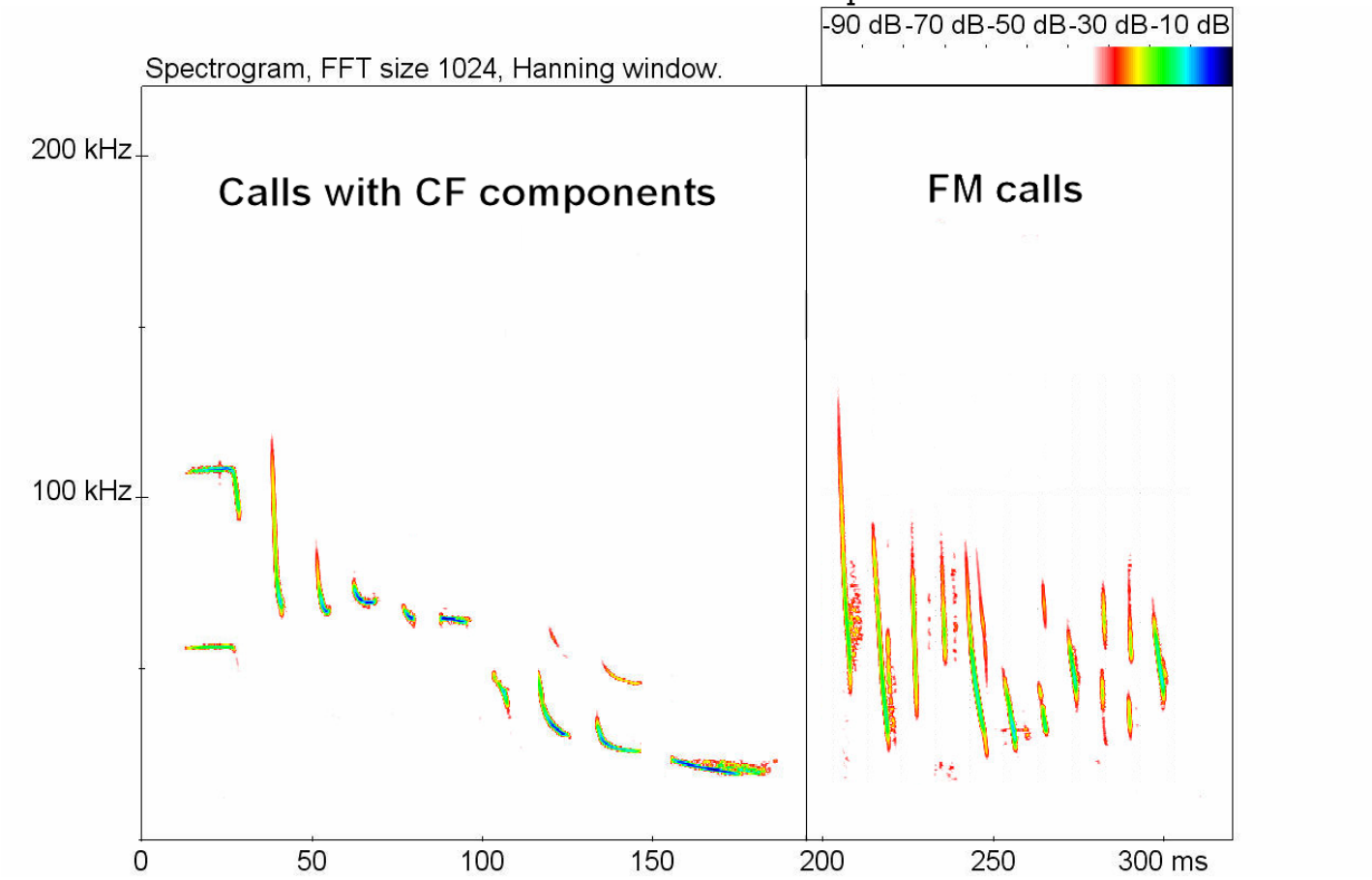
Soprano and common pipistrelle social calls (and two soprano pipistrelle echolocation calls).

Note: These guidelines will only eliminate some of the social calls produced by bats. However, if you misidentify a social call as an echolocation call we will be able to detect this (as it will usually end up being categorised as unknown in the key).

If you do come across a social call, please make a note of it in the BATS analysis sheet

(3) FM call or other call?

FM is the abbreviation of 'Frequency Modulated' and refers to the type of call predominantly produced by some species of British bat. These include the '*Myotis*' species (Daubenton's bat, whiskered bat, Natterer's bat, Brandt's bat, Bechstein's bat) and the '*Plecotus*' species (brown long-eared bat and grey long-eared bat). An FM call is one that doesn't include any CF (constant frequency) component (e.g. a call with a tail). You can see that for some calls this may be difficult to see. However, if you look at the peak frequency of the call (see Step (4)) you'll see that most of the energy (dB) is located at the end (lowest frequency) of the call. Note: Zoom into the call to see whether an obvious CF tail is present.



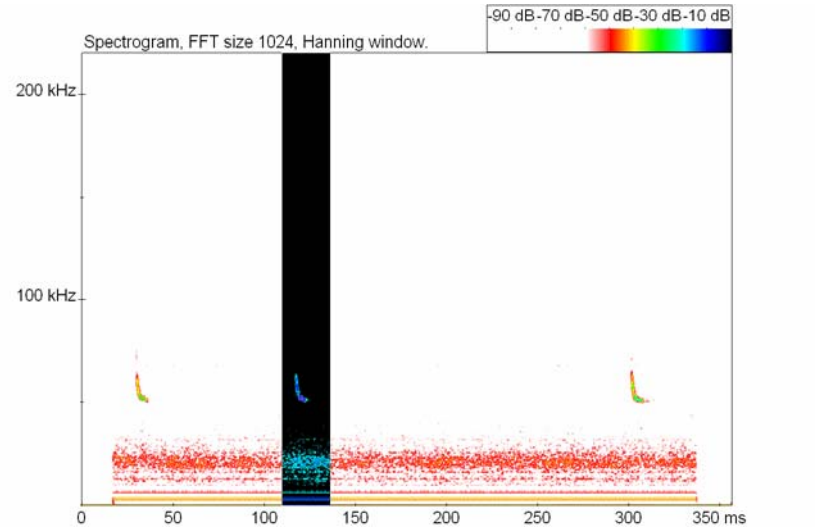
Examples of echolocation calls of British bats. **Note that these are single calls spliced together into a single file!**

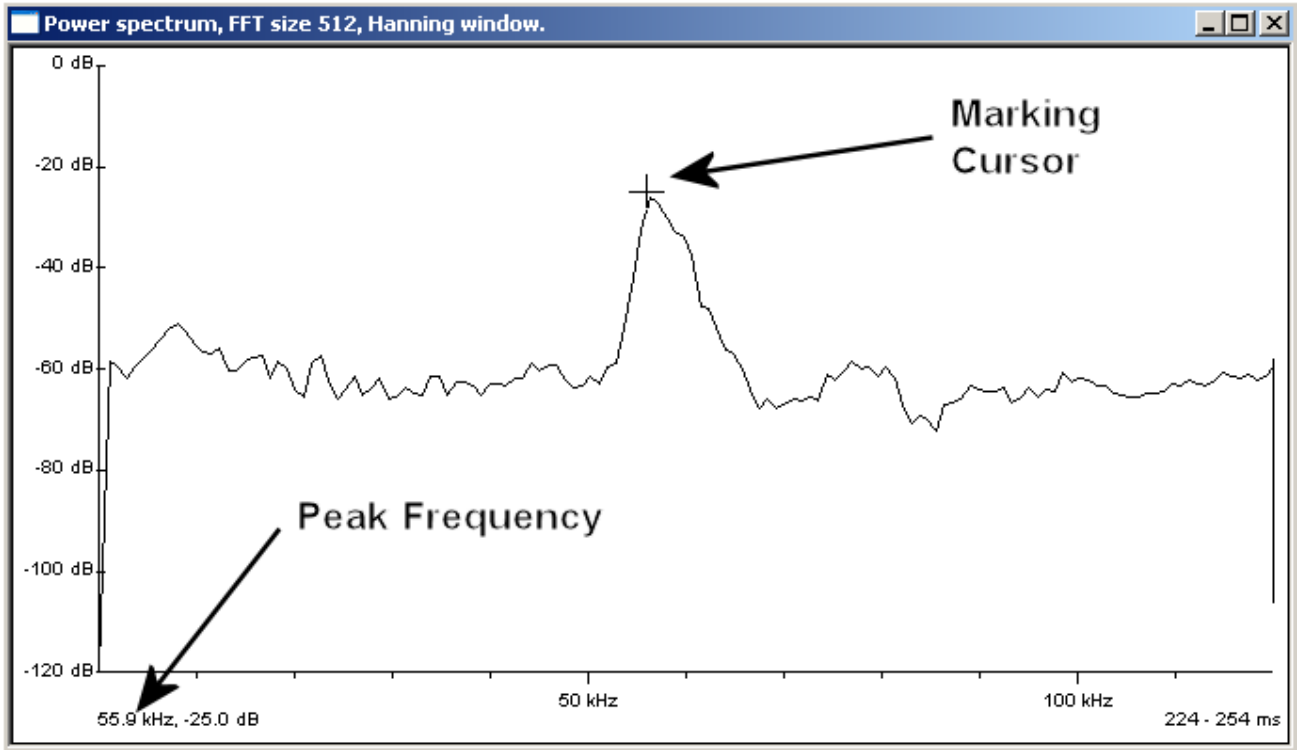
If you decide that the call is an FM call you should enter it into the *Myotis* box (**Myo**) on the BATS analysis sheet. You may decide from your own experience that you can identify the bat as a *Plecotus* species. In which case write **Plec** in the 'Other' box (and include the number of individuals).

(4) Peak Frequency?

In order to identify which species the bat call could belong to it is necessary to determine the peak frequency of the call. To do this:

- Highlight the call in question and select **Analysis-Power Spectrum** from the drop-down menu. (Note: If you cannot highlight anything try right-clicking with the mouse and selecting 'Marking Cursor'.)





l) Move the **Marking Cursor** so that it hovers over the highest peak (i.e. the one closet to 0db on the left hand scale). Then read off the **Peak Frequency** in the bottom left-hand corner.

Note: Make sure you look at the call only. The highest peak, for example, may be at around 10 khz caused by mechanical noise. From the sonogram you should be able to see the range of frequencies covered by the calls (e.g. common pipistrelle sweeps down from about 65 kHz to 45 kHz).

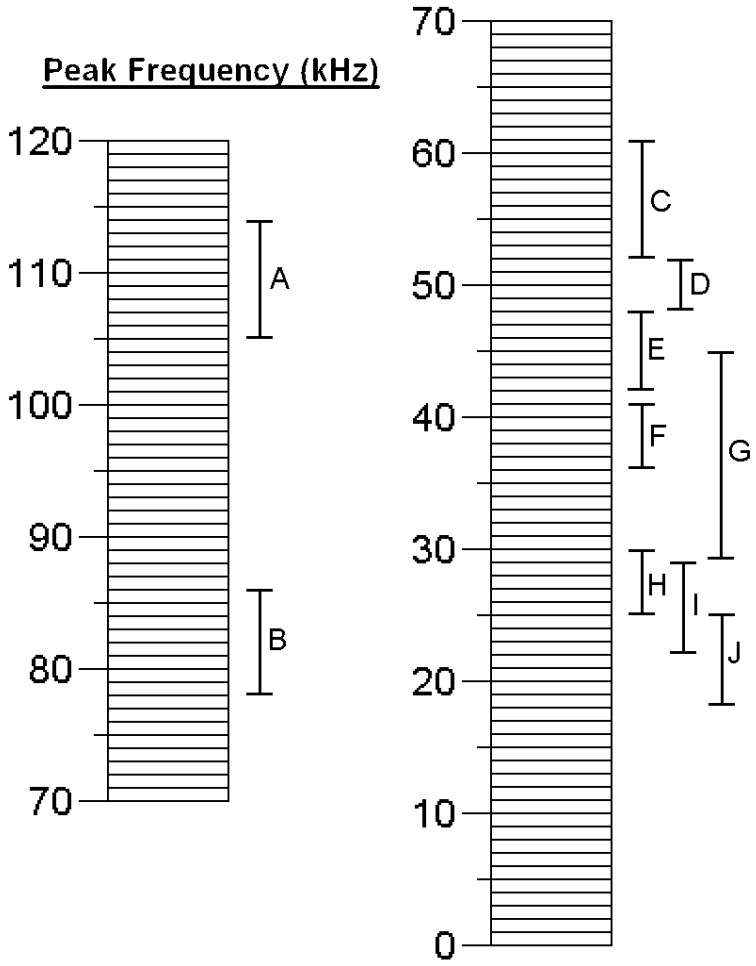
(5) Which Species?

Identify which categories (A-J) the peak frequency falls into from the following diagram and/or Table. Then see which of the call shapes it most resembles from the sonogram.

For example, if you obtain a peak frequency of 40 kHz, this corresponds to the categories F and G.

If you then look at the sonograms in F and G and decide that the shape resemble that of F then you have Nathusius' pipistrelle (**Pnath**).

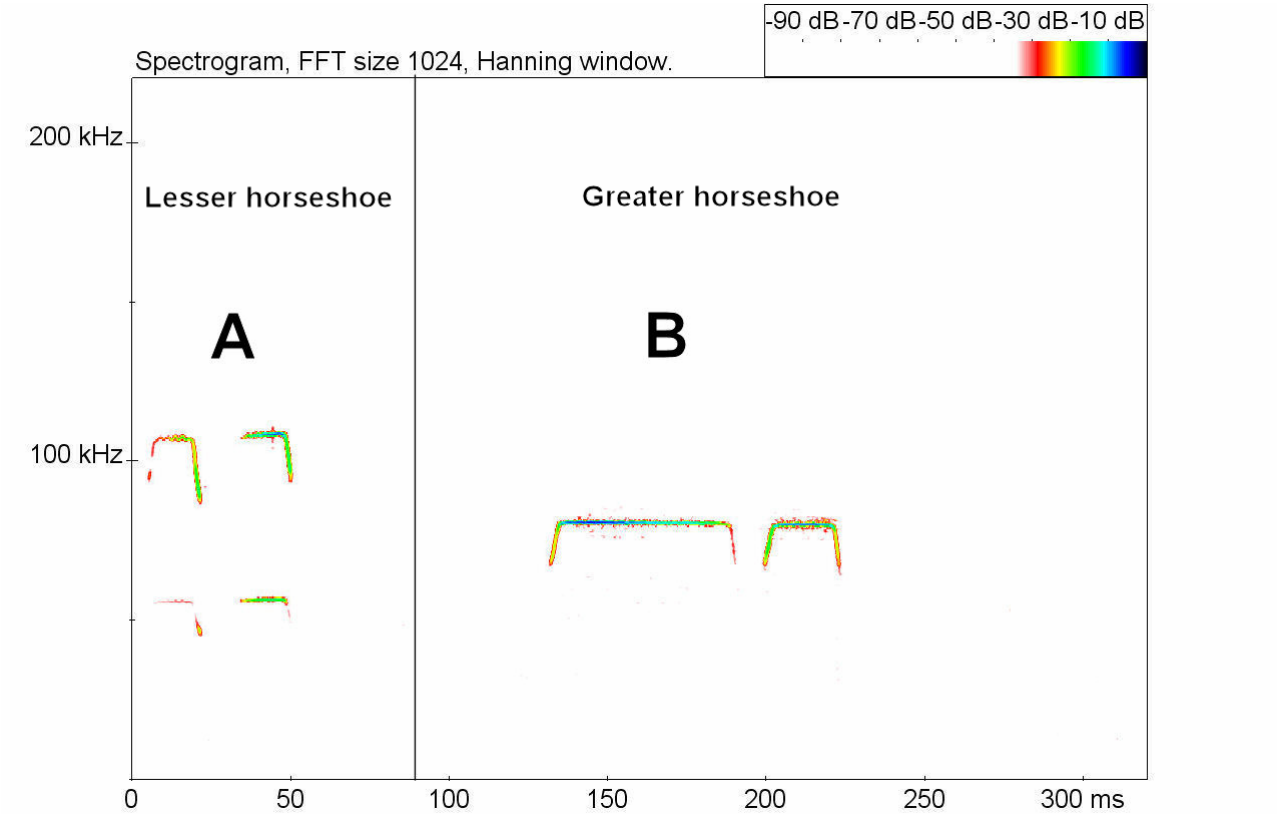
You can, of course, have more than one bat present in a single snapshot. This could be two individuals of the same species or two of different species.



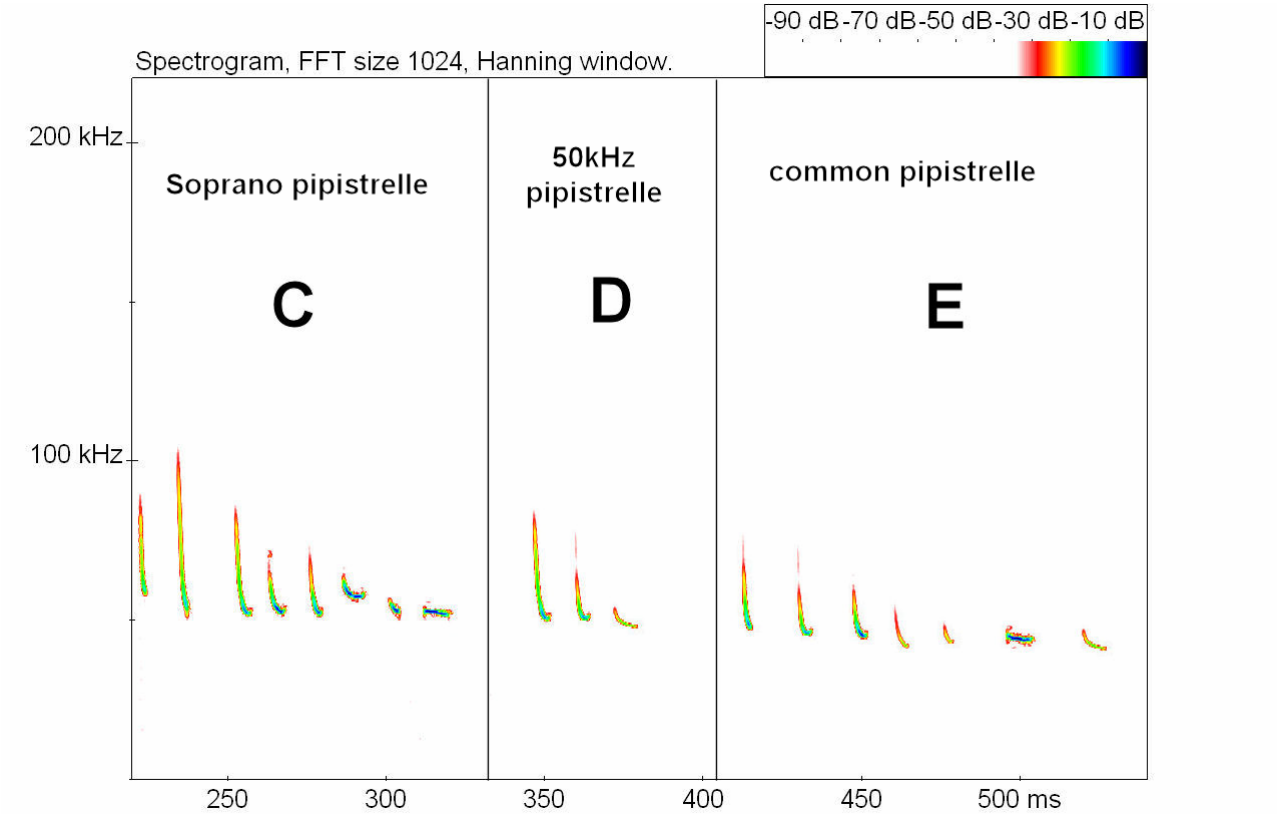
	A	105 - 114 kHz
	B	78 - 86 kHz
*	C	52 - 61 kHz
*	D	48 - 52 kHz
*	E	42 - 48 kHz
	F	36 - 41 kHz
	G	29 - 45 kHz
	H	25 - 30 kHz
	I	22 - 29 kHz
	J	18 - 25 kHz

* most commonly encountered

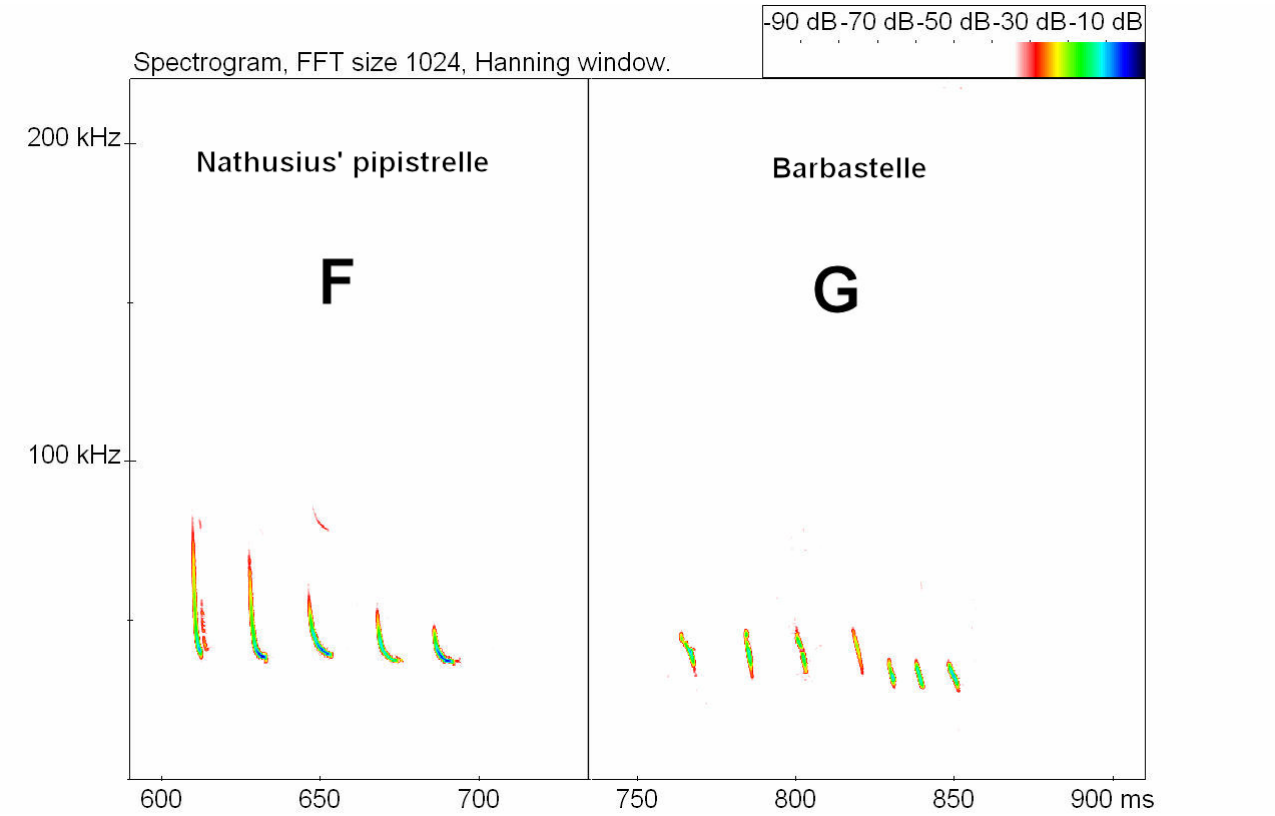
Note that the following calls represent SINGLE call emitted by these species and DO NOT represent a sequence of calls emitted by the species



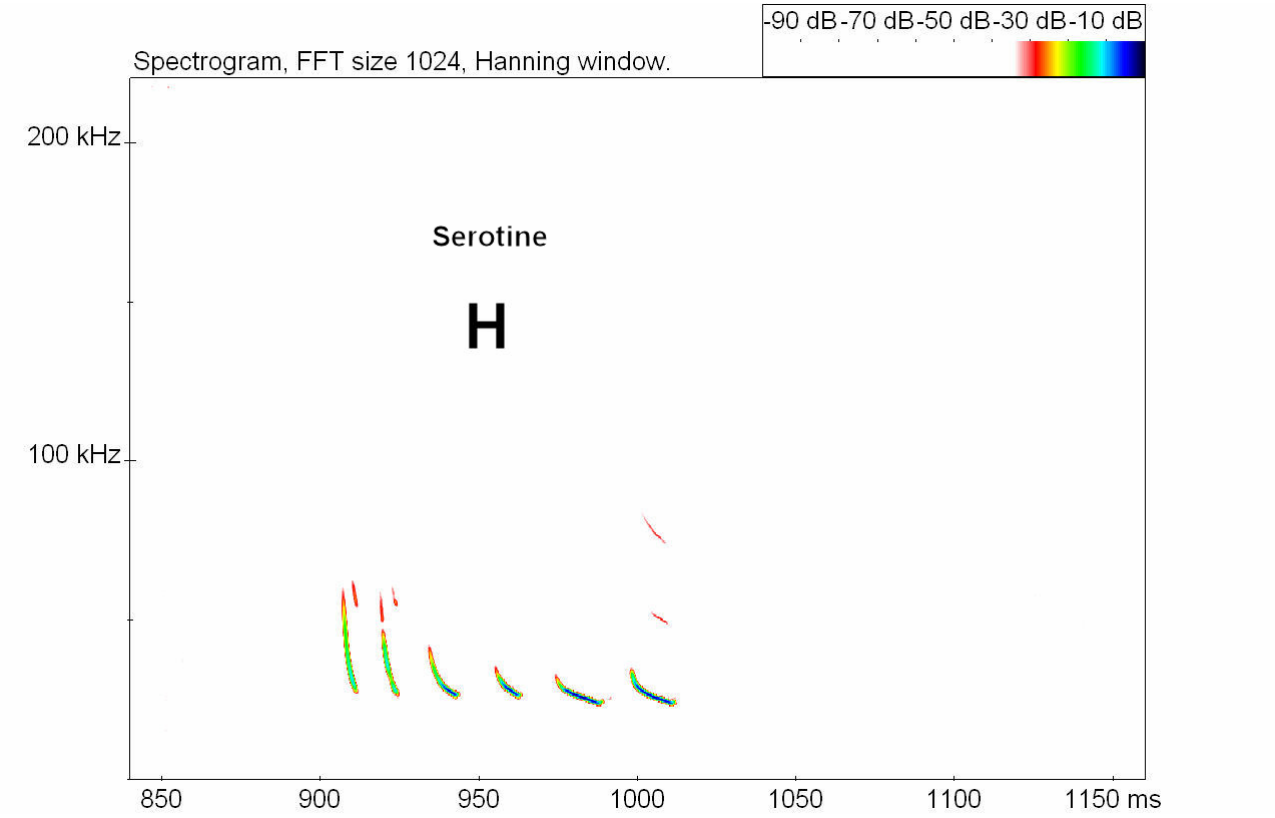
Examples of lesser horseshoe (A) and greater horseshoe (B) echolocation calls. **Note that these are single calls spliced together into a single file!**



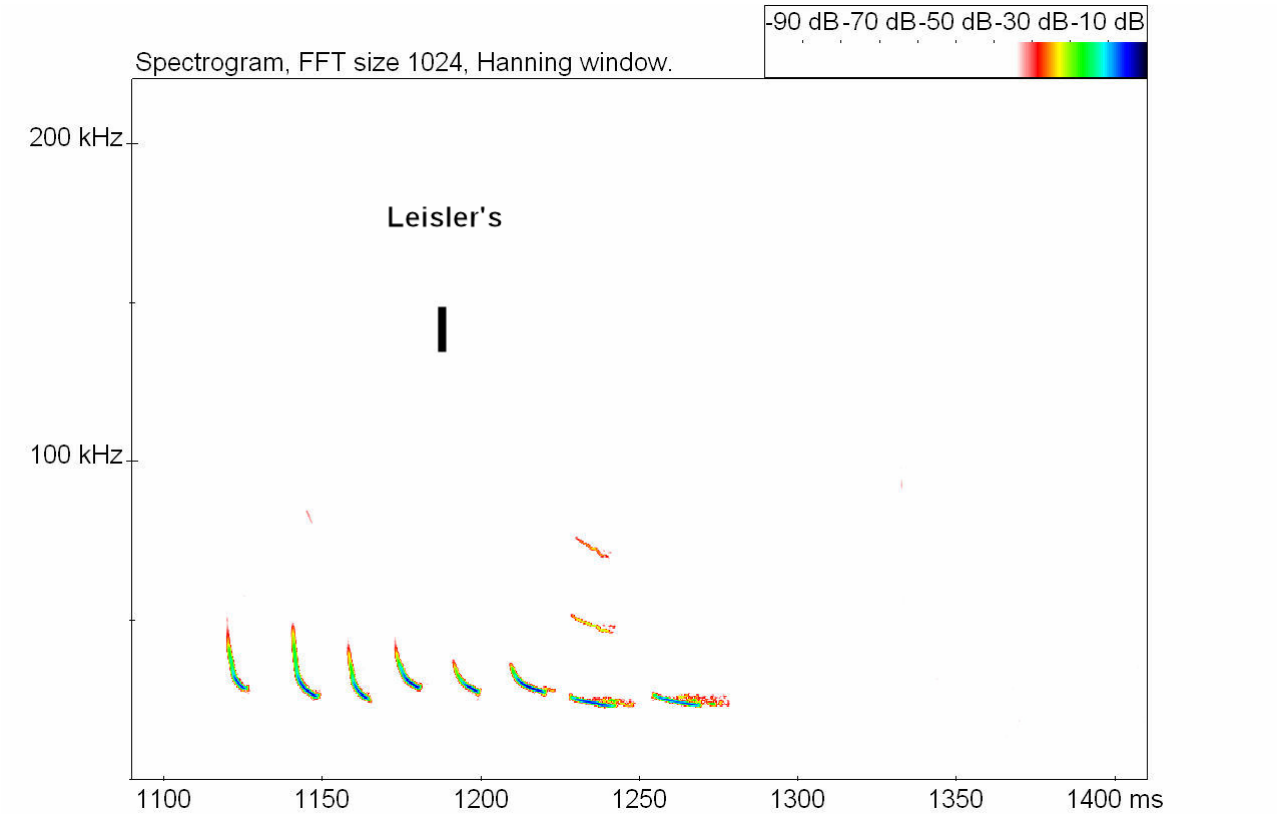
Examples of soprano pipistrelle (C), 50kHz pipistrelle (D) and common pipistrelle (E) echolocation calls. **Note that these are single calls spliced together into a single file!**



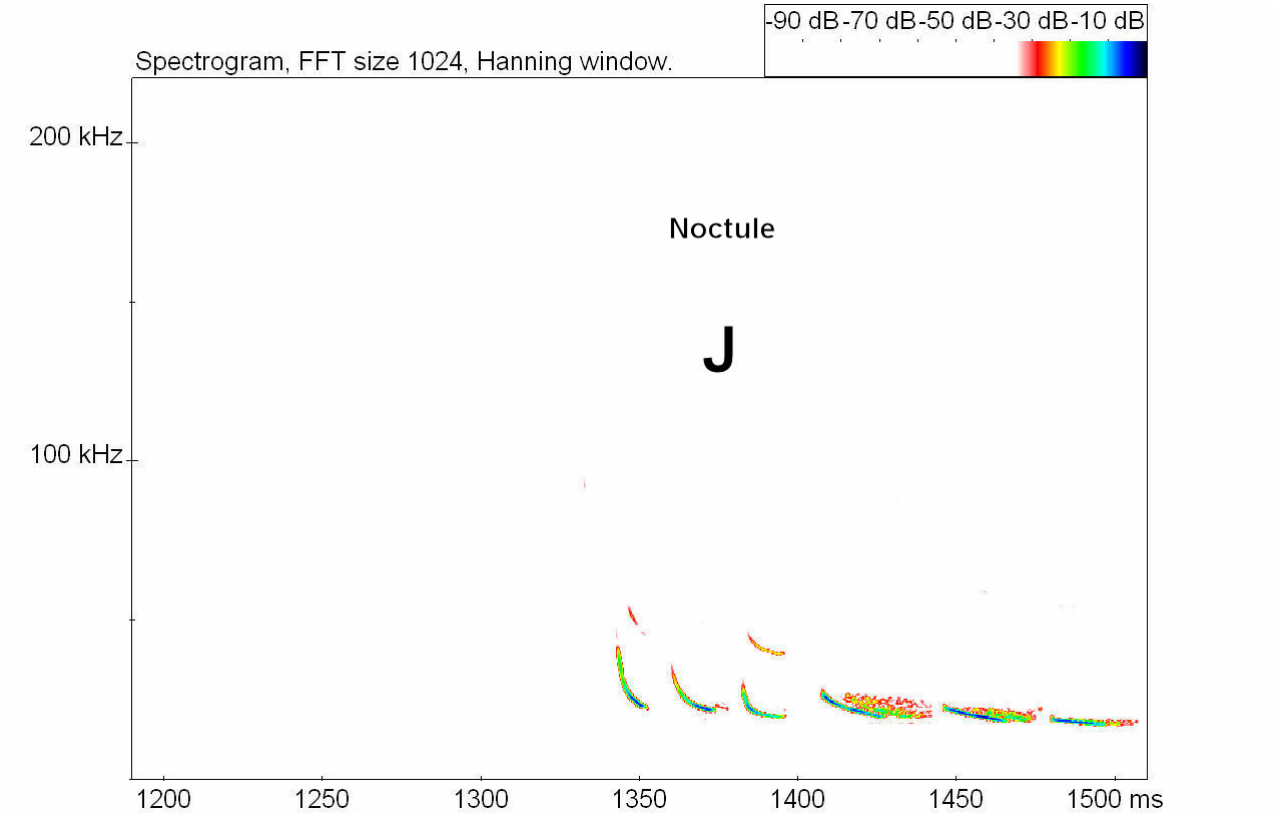
Examples of Nathusius' pipistrelle echolocation calls (F) and Barbastelle echolocation calls (G). **Note that these are single calls spliced together into a single file!**



Examples of serotine echolocation calls. As calls become more CF and 'flattened' (to the right of the diagram) the more likely it is that the identification is correct if the peak frequency is around 26 kHz. **Note that these are single calls spliced together into a single file!**



Examples of Leisler's bat echolocation calls. As calls become more CF and 'flattened' (to the right of the diagram) the more likely it is that the identification is correct if the peak frequency is around 23 kHz. **Note that these are single calls spliced together into a single file!**



Examples of noctule echolocation calls. As calls become more CF and 'flattened' (to the right of the diagram) the more likely it is that the identification is correct if the peak frequency is around 19 kHz. **Note that these are single calls spliced together into a single file!**

APPENDIX 3

Table 1. Survey effort

VOLUNTEER CONTRIBUTION		**Hours**	**Days[1]**
Car Survey			
No. of volunteers participating in surveys = 58			
No. of surveys completed = 72			
Volunteer time for one survey = 4 hrs			
Volunteer effort		360	48
4 Workshops (Dorset, Hampshire, Isle of Wight, Kent)		30	4
IT support		23	3
Sonogram Analysis			
No. of sonogram analysers = 15			
No. of Cds analysed = 62			
Time to analyse sonogram data = 4 hrs			
Volunteer effort		248	33
3 Workshops (Dorset, Hampshire, Isle of Wight)		23	3
	Sub-Total	**683**	**91**
COORDINATOR CONTRIBUTION[2]			
Car Survey			
3 Workshops (Warwickshire, Cardiff, Strathclyde)		23	3
Preparation of standard talk for training days		15	2
Meetings with BCT/MTUK		23	3
Writing and testing standard protocol		135	18
Preparing resource material		15	2
Equipment ordering/construction/processing		53	7
Processing data (inc spreadsheet construction)		30	4
Sonogram Analysis			
Time to process minidisc/CD = 3 hrs			
No. of Cds to processed (inc. failed surveys) = 70			
Processing CDs		210	28
2 workshops (Warwickshire, Stirling)		15	2
Preparation of standard talk for training days		23	3
Writing and testing standard protocol		60	8
Processing data		30	4
			0
Other			0
Emails replied to (received = 638, replied to 300)		75	10
Emails sent		40	5
Telephone		40	5

calls			
Georeferencing of data		30	4
Data archiving		30	4
Data analysis		30	4
Report writing		38	5
	Sub-Total	**913**	**122**
	TOTAL	**1596**	**213**

[1] **@ 7.5 hours per day**
[2] **The Project Co-ordinator made a voluntary contribution of 29 days**

Table 2. Details of all survey routes. Y = completed successfully (e.g. no failed discs, non-returns etc).

Area	Location	Block	Date	Mammal Data	Sonogram Data
England	Avon	ST6065	31/05/2005	Y	
England	Avon	ST7565	20/06/2005	Y	
England	Avon	ST6050	23/06/2005	Y	
England	Avon	ST6080	30/07/2005	Y	Y
Wales	Cardiff/Vale of Glamorgan	SS8565	08/05/2005	Y	Y
Wales	Cardiff/Vale of Glamorgan	SS8580	08/06/2005	Y	Y
Wales	Cardiff/Vale of Glamorgan	ST1580	02/07/2005	Y	Y
Wales	Cardiff/Vale of Glamorgan	ST0065	25/07/2005	Y	
Wales	Cardiff/Vale of Glamorgan	ST0065	05/08/2005	Y	Y
Wales	Cardiff/Vale of Glamorgan	ST0080	09/08/2005	Y	Y
Wales	Cardiff/Vale of Glamorgan	ST0065	14/09/2005	Y	Y
Scotland	Central Scotland	NS5590	07/05/2005	Y	Y
Scotland	Central Scotland	NS7090	04/06/2005	Y	Y
Scotland	Central Scotland	NS8590	25/06/2005	Y	Y
Scotland	Central Scotland	NN5505	15/07/2005	Y	
Scotland	Central Scotland	NS7075	26/07/2005	Y	Y
Scotland	Central Scotland	NS4075	13/08/2005	Y	Y
Scotland	Clyde	NS2560	20/05/2005	Y	Y
Scotland	Clyde	NS4060	29/05/2005	Y	Y
Scotland	Clyde	NS2545	21/06/2005	Y	Y
Scotland	Clyde	NS5545	27/06/2005	Y	Y
Scotland	Clyde	NS5560	25/07/2005	Y	Y
Scotland	Clyde	NS7060	27/07/2005	Y	Y
Scotland	Clyde	NS5545	22/08/2005	Y	Y
Scotland	Clyde	NS4045	01/09/2005	Y	Y
England	Dorset	SY6075	31/05/2005	Y	Y
England	Dorset	SY9090	10/06/2005	Y	
England	Dorset	SZ0590	17/06/2005	Y	
England	Dorset	SY7590	14/07/2005	Y	Y
England	Dorset	SY6090	15/07/2005	Y	Y
England	Dorset	ST6005	16/08/2005	Y	Y
England	Dorset	ST7520	18/08/2005	Y	Y
England	Dorset	SY4590	07/09/2005	Y	
England	Dorset	SY3090	14/09/2005	Y	
England	Hampshire	SU5020	15/05/2005	Y	Y
England	Hampshire	SU0505	29/05/2005	Y	Y
England	Hampshire	SU5005/SZ5090	08/06/2005	Y	Y
England	Hampshire	SU3520/SU2020	30/06/2005	Y	
England	Hampshire	SU5035	21/07/2005		Y

England	Hampshire	SU6520	23/07/2005	Y	Y
England	Hampshire	SZ3590	07/08/2005	Y	Y
England	Hampshire	SU3505	28/08/2005	Y	Y
England	Hampshire	SU3505	25/09/2005	Y	
England	Hampshire	SU6535	27/09/2005	Y	
England	Isle of Wight	SZ3575	07/05/2005	Y	Y
England	Isle of Wight	SZ5075	26/05/2005	Y	Y
England	Isle of Wight	SZ3575	08/06/2005	Y	Y
England	Isle of Wight	SZ5075	22/06/2005	Y	Y
England	Isle of Wight	SZ3575	03/07/2005	Y	Y
England	Isle of Wight	SZ5075	20/07/2005	Y	Y
England	Isle of Wight	SZ3575	13/08/2005	Y	Y
England	Isle of Wight	SZ5075	31/08/2005	Y	
England	Isle of Wight	SZ3575	09/09/2005	Y	Y
England	Isle of Wight	SZ5075	21/09/2005	Y	
England	Kent	TQ5550	13/06/2005	Y	Y
England	Kent	TQ8550	30/06/2005	Y	Y
England	Kent	TR1550	19/07/2005	Y	Y
England	Kent	TQ7035	20/07/2005	Y	Y
England	Kent	TR0050	04/08/2005	Y	Y
England	Kent	TR0035	23/08/2005	Y	Y
England	Kent	TQ5535	26/09/2005	Y	Y
Wales	North Ceredigion	SN4055	26/05/2005	Y	Y
Wales	North Ceredigion	SN7070	21/07/2005	Y	Y
Wales	North Ceredigion	SN7070	16/08/2005	Y	Y
Wales	North Ceredigion	SN6080 (SN5585)	15/09/2005	Y	Y
England	Warwickshire	SP3570	02/05/2005	Y	Y
England	Warwickshire	SP2070	25/05/2005	Y	Y
England	Warwickshire	SP2085	20/06/2005	Y	Y
England	Warwickshire	SP2355	23/06/2005	Y	Y
England	Warwickshire	SP5070	17/07/2005	Y	Y
England	Warwickshire	SP0570	30/07/2005	Y	Y
England	Warwickshire	SP5070	06/08/2005	Y	Y
England	Warwickshire	SP2055	14/08/2005	Y	Y
England	Warwickshire	SO9055	29/09/2005	Y	Y

Table 3. Number of bat species encountered for each survey block surveyed.

			all bats	common pipistrelle	soprano pipistrelle	unidentified pipistrelles	Nathusius' pipistrelle	Myotis spp.	Leisler's bat	noctule	serotine	unidentified bats
Avon	ST6080	30/07/2005	2					1				1
	ST6080 Total		2					1				1
Avon Total			2					1				1
Cardiff/	SS8565	08/05/2005	7	1	6							
Vale of	SS8565 Total		7	1	6							
Glamorgan	SS8580	08/06/2005	63	41	14	1		7				
	SS8580 Total		63	41	14	1		7				
	ST0065	05/08/2005	46	24	13	2		5		1		
		14/09/2005	107	38	15	10		1	1	39	3	5
	ST0065 Total		153	62	28	12		6	1	40	3	5
	ST0080	09/08/2005	103	74	13	10		3		1	2	
	ST0080 Total		103	74	13	10		3		1	2	
	ST1580	02/07/2005	97	82	3	8				3	1	
	ST1580 Total		97	82	3	8				3	1	
Cardiff /Glamorgan Total			423	260	64	31		16	1	44	6	5
CentScot	NS4075	13/08/2005	150	6	101	40		1			1	1
	NS4075 Total		150	6	101	40		1			1	1
	NS5590	07/05/2005	111	4	91	18						
	NS5590 Total		111	4	91	18						
	NS7075	26/07/2005	22	6	15	1						
	NS7075 Total		22	6	15	1						
	NS7090	04/06/2005	112	33	69	9		1				
	NS7090 Total		112	33	69	9		1				
	NS8590	25/06/2005	68	10	42	14				1		1
	NS8590 Total		68	10	42	14				1		1
CentScot Total			463	59	318	82		2		1	1	2
Clyde	NS2545	21/06/2005	12	1	8	3						

	NS2545 Total		12	1	8	3						
	NS2560	21/05/2005	65	2	56	7						
	NS2560 Total		65	2	56	7						
	NS4045	01/09/2005	43	4	27	9			5			
	NS4045 Total		43	4	27	9			5			
	NS4060	29/05/2005	19	3	12	4						
	NS4060 Total		19	3	12	4						
	NS5545	27/06/2005	12	1	8	3						
		22/08/2005	88	27	40	21						
	NS5545 Total		100	28	48	24						
	NS5560	25/07/2005	62	16	40	6						
	NS5560 Total		62	16	40	6						
	NS7060	27/07/2005	9	2	6	1						
	NS7060 Total		9	2	6	1						
Clyde Total			310	56	197	54			5			
Dorset	ST6005	16/08/2005	192	134	23	18		1			11	1
	ST6005 Total		192	134	23	18		1			11	1
	ST7520	18/08/2005	109	74	7	11					17	
	ST7520 Total		109	74	7	11					17	
	SY6075	31/05/2005	52	26	6			1		1	18	1
	SY6075 Total		52	26	6			1		1	18	1
	SY6090	15/07/2005	103	71	12	3		2		2	12	1
	SY6090 Total		103	71	12	3		2		2	12	1
	SY7590	14/07/2005	58	35	5	3		3		2	10	
	SY7590 Total		58	35	5	3		3		2	10	
	SY9090	10/06/2005	1									
	SY9090 Total		1									
	SZ0590	17/06/2005	1									
	SZ0590 Total		1									
Dorset Total			516	340	53	35		7		5	68	3
Hampshire	SU0505	29/05/2005	119	60	35	16				3	4	1

	SU0505 Total		119	60	35	16				3	4	1
	SU3505	28/08/2005	30	22	5	1					2	
	SU3505 Total		30	22	5	1					2	
	SU3520	30/06/2005	5	2	1	2						
	SU3520 Total		5	2	1	2						
	SU5005SZ5090	08/06/2005	42	32	6	1		1				2
	SU5005SZ5090 Total		42	32	6	1		1				2
	SU5020	15/05/2005	76	46	14	2		3	6		4	1
	SU5020 Total		76	46	14	2		3	6		4	1
	SU5035	21/07/2005	98	68	7	22	1					2
	SU5035 Total		98	68	7	22	1					2
	SU6520	23/07/2005	130	68	2	51		1		1	7	1
	SU6520 Total		130	68	2	51		1		1	7	1
	SZ3590	07/08/2005	33	21	7	3					2	
	SZ3590 Total		33	21	7	3					2	
Hampshire Total			533	319	77	98	1	5	6	4	19	7
IOW	SZ3575	07/05/2005	81	61		3		1			12	3
		08/06/2005	44	39		1					3	1
		03/07/2005	113	102	2	1						7
		13/08/2005	81	52		26					3	
		09/09/2005	89	76	2	8		1			1	
	SZ3575 Total		408	330	4	39		2			19	11
	SZ5075	26/05/2005	22	18	1	2					1	
		22/06/2005	100	88	4	1	1	1		1	4	
		20/07/2005	154	138	1	3		4		1	3	4
		31/08/2005	1									
		21/09/2005	1									
	SZ5075 Total		278	244	6	6	1	5		2	8	4
IOW Total			686	574	10	45	1	7		2	27	15
Kent	TQ5535	26/09/2005	28	17	3	4			1			3
	TQ5535 Total		28	17	3	4			1			3

	TQ5550	13/06/2005	61	50	2	1	2	5	1			
	TQ5550 Total		61	50	2	1	2	5	1			
	TQ7035	20/07/2005	80	55	11	13						
	TQ7035 Total		80	55	11	13						
	TQ8550	30/06/2005	62	43	9	8					1	
	TQ8550 Total		62	43	9	8					1	
	TR0035	23/08/2005	60	45	4	9		1				1
	TR0035 Total		60	45	4	9		1				1
	TR0050	04/08/2005	97	45	18	29		1		4		
	TR0050 Total		97	45	18	29		1		4		
	TR1550	19/07/2005	73	46	16	6				4	1	
	TR1550 Total		73	46	16	6				4	1	
Kent Total			461	301	63	70	2	7	2	8	2	4
NorCered	SN4055	26/05/2005	159	73	57	32		1	1	1	1	1
	SN4055 Total		159	73	57	32		1	1	1	1	1
	SN6080	15/09/2005	204	83	50	39						16
	SN6080 Total		204	83	50	39						16
	SN7070	21/07/2005	113	66	24	21		1				1
		16/08/2005	49	29	11	7		1			1	
	SN7070 Total		162	95	35	28		2			1	1
NorCered Total			525	251	142	99	0	3	1	1	2	18
Warks	SO9055	29/09/2005	43	29	4	7		1			1	1
	SO9055 Total		43	29	4	7		1			1	1
	SP0570	30/07/2005	173	133	24	11				2	1	1
	SP0570 Total		173	133	24	11				2	1	1
	SP2055	14/08/2005	118	101	2	2		6	1	5		1
	SP2055 Total		118	101	2	2		6	1	5		1
	SP2070	25/05/2005	86	42	6	6			2	28	2	
	SP2070 Total		86	42	6	6			2	28	2	
	SP2085	20/06/2005	59	50	2	1		4		2		
	SP2085 Total		59	50	2	1		4		2		

	SP3555	23/06/2005	53	41		1		7	1	3		
	SP3555 Total		53	41		1		7	1	3		
	SP3570	02/05/2005	28	20		7		1				
	SP3570 Total		28	20		7		1				
	SP5070	17/07/2005	78	54		9		1		14		
		06/08/2005	55	50	3	1		1				
	SP5070 Total		133	104	3	10		2		14		
Warks Total			693	520	41	45		21	4	54	4	3
(blank)	(blank)	(blank)										
	(blank) Total											
(blank) Total												
Grand Total			4719	2744	985	582	4	70	19	119	129	60

Table 4. Mammals encounters along transect routes. Numbers in brackets indicate dead mammals

			hedgehog	mole	bat	rabbit	hare	squirrel	shrew	field vole	bank vole	vole	wood mouse	mouse	rat	fox	badger	mink	stoat	pole cat	deer	roe deer	unknown	Grand Total
Avon	ST6050	23/06/2005	(1)		5											1								6 (1)
	ST6065	31/05/2005			2	(1)											(1)							2 (2)
	ST6080	30/07/2005			9	1								2		2								14 ()
	ST7565	20/06/2005			6	1								1		1					1			10 ()
Cardiff/ Vale	SS8565	08/05/2005				3																		3 ()
Of Glamorgan	SS8580	08/06/2005				(1)									1	1								2 (1)
	ST0065	25/07/2005																						()
		05/08/2005	1 (1)			2 (1)																		3 (2)
		14/09/2005											1											1 ()
	ST0080	09/08/2005				2					1					1								4 ()
	ST1580	02/07/2005	1									1		1										3 ()
CentScot	NN5505	15/07/2005					(1)																	(1)
	NS4075	13/08/2005	1			1																		2 ()
	NS5590	07/05/2005																	1			1		2 ()
	NS7075	26/07/2005				4	1			1								1						7 ()
	NS7090	04/06/2005	1			4	1									1								7 ()
	NS8590	25/06/2005	1			1																		2 ()
Clyde	NS2545	21/06/2005	1		1	1	2																	5 ()
	NS2560	20/05/2005			2	5 (1)										1							1	9 (1)
	NS4045	01/09/2005	2			1										1							2	6 ()
	NS4060	29/05/2005			4	1										1								6 ()
	NS5545	27/06/2005			2								(1)			4								6 (1)
		22/08/2005						(1)								3								3 (1)
	NS5560	25/07/2005														1								1 ()
	NS7060	27/07/2005		(1)	1	1 (1)																	1	3 (2)
Dorset	ST6005	16/08/2005			1			(1)																1 (1)

	ST7520	18/08/2005			1	2		(3)															3 (3)
	SY3090	14/09/2005				1											1						2 ()
	SY4590	07/09/2005				1																	1 ()
	SY6075	31/05/2005				1										3	2					1	7 ()
	SY6090	15/07/2005														1				1			2 ()
	SY7590	14/07/2005				1										2					1		4 ()
	SY9090	10/06/2005			1	1 (1)	1									1							4 (1)
	SZ0590	17/06/2006				6 (6)								(1)									6 (7)
Hampshire	SU0505	29/05/2005				4								1								1	6 ()
	SU3505	28/08/2005			2											1						1	4 ()
	SU3520/SU2020	30/06/2005																					()
	SU5005/SZ5090	08/06/2005				1 (1)								1		2	1					(1)	5 (2)
	SU5020	15/05/2005	1			4		(2)						1		2						1	10 (2)
	SU6520	23/07/2005				2			1					2		1							6 ()
	SZ3590	07/08/2005	1		8		2		1				1										13 ()
IOW	SZ3575	07/05/2005				1 (2)																(1)	2 (3)
		08/06/2005				(4)										1							1 (4)
		03/07/2005				5 (2)										2						(2)	12 (4)
		13/08/2005				2										1							3 ()
		09/09/2005				(1)				1			1			1 (1)							3 (2)
	SZ5075	26/05/2005			1	4									1	1							7 ()
		22/06/2005				3 (2)						1										1	5 (2)
		20/07/2005				5							1			1	1						8 ()
		31/08/2005											1		1								2 ()
		21/09/2005				6									1								7 ()
Kent	TQ5535	26/09/2005																					()
	TQ5550	13/06/2005				1										3							4 ()
	TQ7035	20/07/2005	1		6	2 (2)										1							10 (2)
	TQ8550	30/06/2005				2	1								(1)	2							5 (1)
	TR0035	23/08/2005				(1)										(3)							(4)
	TR0050	04/08/2005			1	3 (1)	1								1								6 (1)
	TR1550	19/07/2005				(2)																	(2)
NorCered	SN4055	26/05/2005																					()

	SN6080	15/09/2005																						()
	SN7070	21/07/2005	1			3										1								5 ()
		16/08/2005				1		(1)	1					1										3 (1)
Warks	SO9055	29/09/2005				1																		1 ()
	SP0570	30/07/2005			3	1 (1)										1	1							6 (1)
	SP2055	14/08/2005	(1)		5	7 (1)								1										13 (2)
	SP2070	25/05/2005	1		1	10										1							1	14 ()
	SP2085	20/06/2005	(1)		2	2 (2)										1								5 (3)
	SP3555	23/06/2005				1							1			1	1							4 ()
	SP3570	02/05/2005	2 (1)			6 (1)										1								9 (2)
	SP5070	17/07/2005			4	4 (3)			1															9 (3)
		06/08/2005				7												1				1		9 ()
Grand Total			15 (5)	(1)	68	129 (38)	9 (1)	(8)	4	2	1	2	6 (1)	11 (1)	5 (1)	50 (4)	7 (1)	2	1	1	2	4	7 (4)	334 (65)

Table 5. Mean bat encounters per kilometre for each county and species

	allbats	45pip	55pip	50pip	pnath	myotis	leis	noct	sero	other
Avon	0.041	0.000	0.000	0.000	0.000	0.021	0.000	0.000	0.000	0.021
Cardiff/VoG	1.460	0.897	0.221	0.107	0.000	0.055	0.003	0.152	0.021	0.017
CentScot	1.917	0.244	1.317	0.340	0.000	0.008	0.000	0.004	0.004	0.008
Clyde	0.802	0.145	0.510	0.140	0.000	0.000	0.013	0.000	0.000	0.000
Dorset	1.526	1.006	0.157	0.104	0.000	0.021	0.000	0.015	0.201	0.009
Hampshire	1.379	0.826	0.199	0.254	0.003	0.013	0.016	0.010	0.049	0.018
IOW	1.420	1.188	0.021	0.093	0.002	0.014	0.000	0.004	0.056	0.031
Kent	1.364	0.890	0.186	0.207	0.006	0.021	0.006	0.024	0.006	0.012
NorCered	2.717	1.299	0.735	0.512	0.000	0.016	0.005	0.005	0.010	0.093
Warks	1.594	1.196	0.094	0.104	0.000	0.048	0.009	0.124	0.009	0.007
Grand Total	1.628	0.947	0.340	0.201	0.001	0.024	0.007	0.041	0.045	0.021

Table 6. Results of statistical test carried out on climatic variables. Correlations were performed on temperature data (coefficients presented) and ANOVAs were carried out on Wind and Cloud variables. NS = not significant. * = p < 0.05.

	Temp Start	Temp End	Wind Start	Wind End	Cloud Start	Cloud End
all bats	0.261*	NS	NS	NS	NS	NS
common pipistrelle	0.428*	0.366*	NS	NS	NS	NS
soprano pipistrelle	NS	NS	NS	NS	NS	NS
Myotis spp.	NS	NS	NS	NS	NS	NS
Leisler's bat	NS	NS	NS	NS	NS	NS
noctule	NS	NS	NS	NS	NS	NS
serotine	NS	NS	NS	NS	NS	NS

Table 6. Owl encounters along transects

			tawny owl	little owl	barn owl	owl
CentScot	NS7075	26/07/2005	1			
Clyde	NS5545	22/08/2005				1
	NS5560	25/07/2005				1
	NS7060	27/07/2005				1
IOW	SZ5075	22/06/2005			1	
Kent	TQ8550	30/06/2005	1	1	1	
NorCered	SN7070	16/08/2005	1			
Warks	SP2055	14/08/2005		1	1	1
Grand Total			3	2	3	4

Table 7. Species occurring within each ITE land class covered during the survey

ITE Land Class	common pipistrelle	soprano pipistrelle	Myotis species	Leisler's bat	noctule	serotine	Total
1	469	76	17	3	43	31	**639**
2	526	80	20	7	11	57	**701**
3	421	28	6	1	1	19	**476**
4	211	18	3	0	10	8	**250**
5	103	40	3	1	25	3	**175**
6	42	11	5	0	4	0	**62**
7	19	5	0	0	0	4	**28**
8	128	13	0	0	0	2	**143**
9	119	5	2	0	12	0	**138**
10	86	1	2	1	5	0	**95**
11	74	3	3	0	3	0	**83**
12	3	3	0	0	0	0	**6**
13	16	12	0	0	0	0	**28**
14	137	73	2	1	0	1	**214**
15	4	6	0	0	0	0	**10**
18	30	13	0	0	0	0	**43**
19	67	35	1	0	0	1	**104**
20	8	4	0	0	0	0	**12**
26	0	1	0	0	0	0	**1**
28	4	10	0	0	0	0	**14**
29	1	53	0	0	0	0	**54**
30	4	10	1	0	0	0	**15**
31	0	13	0	0	0	0	**13**
32	0	3	0	0	0	0	**3**
33	40	130	0	0	0	0	**170**
34	41	234	1	4	0	1	**281**
35	14	40	0	1	0	0	**55**
36	9	15	0	0	0	0	**24**
38	0	0	0	0	0	0	**0**

Table 8. Numbers of terrestrial mammal species encountered occurring in Environmental Zones

	Environmental Zone					
	1	**2**	**3**	**4**	**5**	**6**
badger	5	5				
bank vole						
bat	24	35		10		
deer	2					
field vole	1				1	
fox	27	10	1	8	3	
hare	2	2		3	1	1
hedgehog	3	7	1	6		
mink	1				1	
mole				1		
mouse	7	3	1			
pole cat	1					
rabbit	82	54	4	17	1	2
rat	6	1				

roe deer	1	1			1
shrew	2	1	1		
squirrel	4	3	1	1	
stoat				1	
unknown	5	3		4	
vole	1				
wood mouse	7	1		1	